PETROLEUM PROCESSING

including Petrochemical Processing Section

APRIL 1952

New Autofining Process

It uses cobalt-molybdate catalyst to remove sulfur from a wide range of stocks—p. 467

Motor Oil Blending

Modern methods using continuous equipment do a better job—p. 470

What Is a Petrochemical?

Here's our definition of what the term means—with comments from others and some interesting background—p. 490

Petrochemical Directory

A listing of over 220 plants in operation or being built by some 100 companies—p. 509

The Petrochemical Industry

How Big Will It Grow?

It's booming today and will continue to boom—because oil brings market and price stability to its products

. . . p. 492

FOR MICROMETER ACCURACY IN FLUID FEEDING

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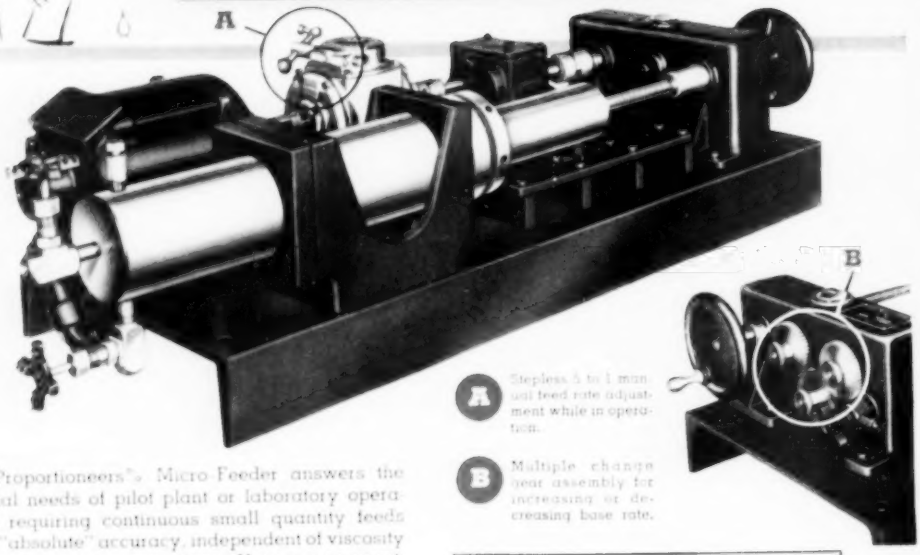

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What our films may lack in glamour, they most certainly make up in educational value. The subjects are ones that are close to the heart of any petroleum man trying to make better products, train his people to handle fuels more safely, or assist his customers to get more from the fuels and lubricants he supplies.

A glance at the following page will give you a good idea of the films we have available . . . and probably suggest uses for them in your own operations.

continued on next page

ETHYL
ETHYL CORPORATION

Slightly Colossal

continued from preceding page

Fire Power A 14 minute film on the safe handling of gasoline, particularly in service stations and bulk plants.

Fundamentals of Fuel Knock A highly technical report of fuel combustion studies being conducted at M.I.T. under an Ethyl grant. Running time 55 minutes.

You're the Doctor An interesting story about farm equipment service "in practice" for a sales job on a tractor engine. 23 minutes.

There Is a Difference Tells of a new service station operator learning about customer relations. Running time 20 minutes.

Gasoline for Everybody A brief but complete story of how gasoline is made and its importance to daily living. Running time 33 minutes.

Pattern for Progress A 20 minute color film about the influence of tractor power on agriculture as seen through the eyes of one farm family.

We will be happy to send you a complete catalogue of films in the Ethyl library. If you need a particular film in a hurry, our regional offices maintain a full stock for quick service. Of course, there is no charge for these films. They are a part of Ethyl's service to the oil industry.

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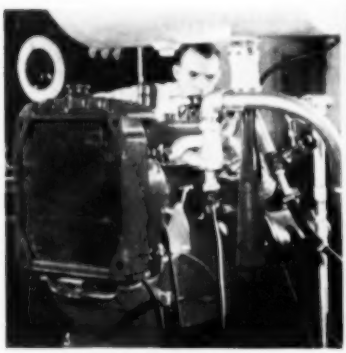

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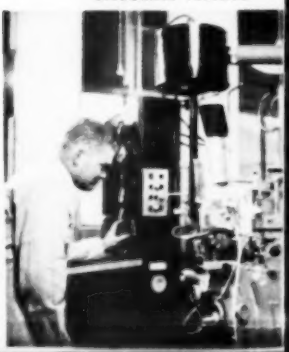

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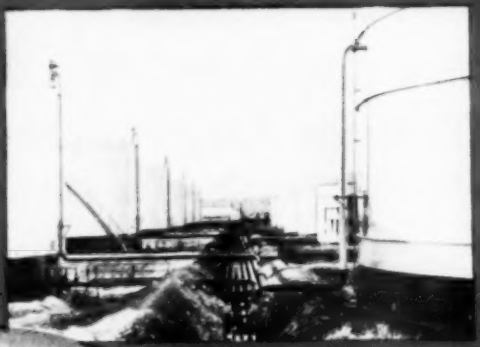

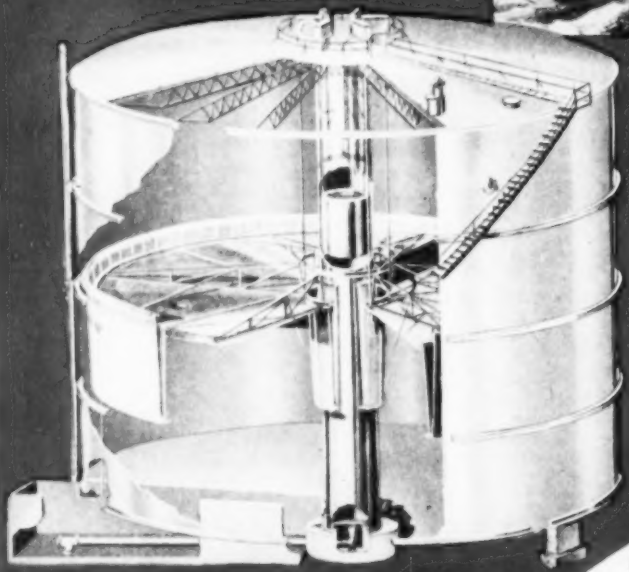

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PETROLEUM PROCESSING

Covering petroleum research and the design, management, operation and maintenance of plants processing hydrocarbon materials into fuels, lubricants and chemicals

April, 1952
Vol. 7, No. 4

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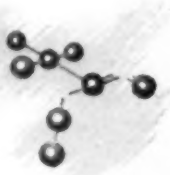

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Publisher's Page

DEAR READER:

"Petrochemical Processing" is a new editorial section starting this month as a major addition to the editorial content and scope of this magazine. It is a development that has been dictated by the rapidly growing market for plastics, synthetic fibers, detergents, and many other new chemical products in our economy.

The availability of large volume, low cost chemical raw materials derived from petroleum and natural gas has been a major factor in the post war development of these products. The petroleum, gas and chemical industries have made vast investments in research and in plant facilities to make this development possible. Petroleum and gas companies, with their control of the supply of crude petroleum and natural gas and their experience in the technology of processing these hydrocarbons, have a real stake in this relatively new petrochemical industry, called such for the moment because of the petroleum and gas industry being the greatest natural source of supply. Equally great is the stake of chemical companies concerned with the intermediate fabrication and sale of these chemical raw materials.

What better editorial challenge or publishing opportunity could exist for a technical business publication than to disseminate necessary information to this rapidly expanding petrochemical industry? Our new "Petrochemical Processing" section is a major step in this direction, and we believe a natural one, dictated by the requirements and desires of our readers. We also believe that it is more logical that this new industry look to PETROLEUM PROCESSING for petrochemical technology than to an old line chemical publication because of the highly specialized nature of the petroleum processing industry, the closely related applications of its technology to petrochemical processing, and their common source of raw materials.

In planning for this new editorial section the inevitable question, "What is a petrochemical?", arose. No two men on our staff agreed—nor did we find any greater unanimity among our readers in the industry. In fact, some industry executives were even adamant that there was no such thing as a "petrochemical". We've tried to clear the air on this point with the story on page 490.

Changes that develop in the economics of competitive sources of raw materials for the manufacture of these chemical products will be reported to you in PETROLEUM PROCESSING as they become news. In the meantime, we will describe in this new "Petrochemical Processing" section the methods by which chemicals are produced in refineries and natural gasoline plants; in some instances, the immediate steps in their further manufacture into intermediate chemicals; the conditions that must be met to make and market petrochemicals successfully; the growth of markets, the development of new products and their applications, among other subjects.

We hope you like the new section, that you read it, and that you report back to us ways in which we can make it more valuable to you.

Sincerely Yours

A. W. BOULTON

Other Platt Petroleum Publications

National Petroleum News
The weekly oil marketing magazine, covering news prices, transportation, storage, merchandising

Platt's Oilgram News
A daily independent oil news reporting service issued from New York, Cleveland and Houston

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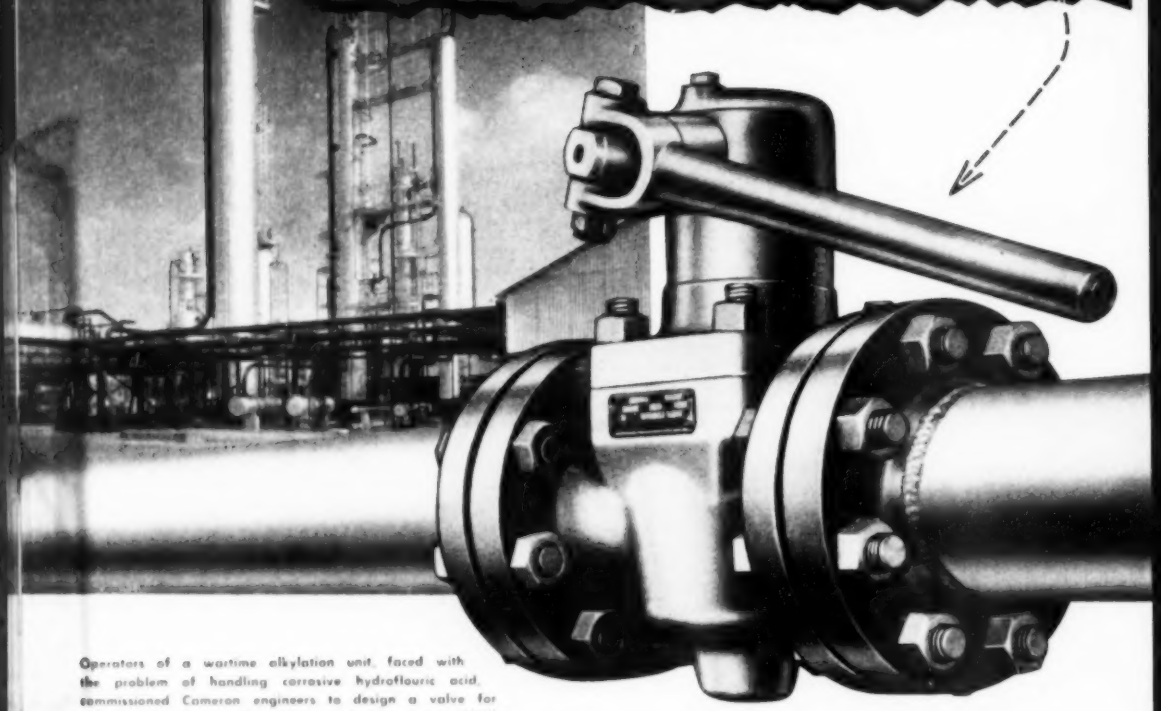
planning an alkylation unit?

This valve was tailor-made for you!



Operators of a wartime alkylation unit, faced with the problem of handling corrosive hydrofluoric acid, commissioned Cameron engineers to design a valve for that specific service. The Cameron Non-Lubricated Lift-Plug Valve is the result. It combines the best features of conventional valves with such innovations as a separate, renewable seat and a unique plug actuator which, in ¼-turn of the operating lever, lifts the plug free of the seat, then rotates the plug to open or closed position, and reseats the plug. The separate seat not only permits any desired trim for specific services and facilitates maintenance of the valve, it also provides a seat for the plug which does not distort with the body due to line strains. Consequently, no lubricant is required either to effect a seal or for easy operation.

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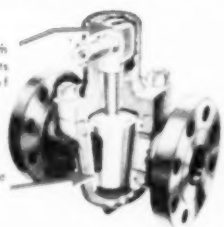

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SELLING THROUGH SUPPLY STORES

What's Happening . . .

Expansion

REFINERY EXPANSION PROGRAM has been approved by Defense Production Administration—calling for building of new basic capacity in U.S. at annual rate of 500,000 b/d during 18-month period beginning with 3rd quarter of this year. DPA-approved program is slightly higher than program PAD had recommended, which called for expansion during same period at annual rate of 475,000 b/d (What's Happening, Feb. '52, p. 127).

DPA approval qualifies projects for rapid tax amortization. It was understood that PAD already had sufficient applications on hand to meet new expansion goals at time approval was announced—March 27, and that processing of these applications already has begun.

In addition to refinery expansion, program also calls for drilling 80,000 new wells during same 18-month period, building 19,700 miles of pipe lines, and increasing tankage (including refinery tankage) by 153,113,000 bbls. These figures do not include gas industry, for which a separate program is being planned by PAD.

. . . **Atlantic Refining Co.** has awarded M. W. Kellogg Co. contract for design and construction of a 45,000 b/d Orthoflow catalytic cracking unit and 3,500 b/d sulfuric acid alkylation plant at its Philadelphia (Point Breeze) refinery (What's Happening, June '51, p. 571). Construction will start this spring, with completion scheduled for 1953. Fluid unit reportedly will be largest of Orthoflow type yet built.

. . . **Leonard Refineries** is increasing capacity of its Alma, Mich., refinery to 18,000 b/d from present 10,000 b/d. Major installation is a new 10,000 b/d crude vacuum distillation unit, with extensive revamping of gas recovery facilities and addition of new cooling tower and other necessary auxiliaries. Also included in program is revamping of feed preparation and product recovery sections of Leonard's Thermofor catalytic cracking unit, to increase its capacity to 7,000 b/d. Catalytic Construction Co. has contract. Completion of new crude unit is expected in 1st quarter of '53, with gas plant being finished in 3rd quarter of this year.

. . . **Eastern States Petroleum Co.**, Houston, has signed contract with Armed Services Petroleum Purchasing Agency calling for rehabilitation of its existing but non-operative HF alkylation unit to produce approximately 2100 b/d of alkylate. This will enable Eastern States to produce approximately 5000 b/d of grade 100/130 avgas.

. . . **The Texas Co.** is planning a $44,550,000 lubricating oil project at its Lockport, Ill. works, for which rapid tax write-off has been granted. Lube plant will produce 3485 b/d high viscosity motor and aircraft lubes, cost approximately $17,622,000, plus auxiliary facilities, $11,974,000. Increasing crude throughput 25,000 b/d, increasing avgas production 740 b/d and motor gasoline 11,721 b/d will cost approximately $14,954,000; this portion of project has not yet been certified.

. . . **Midland Cooperative Wholesale** has let contract to Refinery Engineering Co. for modernization and expansion of its Cushing, Okla. refinery. Plant capacity will be increased to 10,000 b/d; present capacity is 4,600 b/d.

. . . **Cities Service Oil Co. (Del.)** will build a natural gasoline plant near Blackwell, Okla., capable of producing approximately 200,000 gal. total of isobutane, butane, propane and natural gasoline from approximately 155,000 Mcfd. of natural gas. The project includes a pipeline to move products to the Ponca City refinery. About 250 high pressure tank cars will be added to the company fleet to move LP-Gas to underground storage locations and distribution points. Hudson Engineering Co. will begin construction shortly, with completion expected early next year.

. . . **Shell Oil Co.** is increasing capacity of two California refineries by 25,000 b/d. At Wilmington, a new crude distillation unit with 52,000 b/d capacity will replace two existing units and increase plant capacity by 20,000 b/d to 86,000 b/d. Now in design, this unit is expected to be operating early in 1954. At Martinez throughput is being increased 5,000 bbls. to 36,000 b/d by "extending" an existing crude distillation unit. Completion is expected in late September.

Petrochemicals

. . . **Stanolind Oil & Gas Co.** has let contract to Girdler Corp. for a sulfur recovery unit at the North Cowden gasoline plant, located 15 miles northwest of Odessa, Texas, and operated by Stanolind for a group of owners. Unit will have a design capacity of 17.7 long tons per day, and is expected to be completed early in 1953. Feed gas contains 58% hydrogen sulfide. Stanolind is currently installing another sulfur recovery unit at the Slaughter gasoline plant near Sundown, Texas. Fluor Corp. is building, with completion of this 49 ton/day unit expected in September.

. . . **Monsanto Chemical Co.** expects to market "substantial amounts" of its new Krilium soil conditioner in time for next spring's home garden needs, and for agricultural and erosion control purposes, according to company president Charles Allen Thomas. Company plans to manufacture Krilium in presently available equipment at several plants rather than build a new plant for it at this time.

. . . **Union Oil Co. of California** has established a by-products chemical division responsible for both manufacture and marketing. Heading up the new operation is Harvey Fifer, formerly superintendent of Union's lube treating department in the Oleum

Information on these pages is obtained through the nation-wide news coverage service of PLATT'S OILGRAM NEWS

(Calif.) refinery. Company currently is building a 50 ton/day sulfur recovery unit and a 50 ton/day ammonium sulfate plant (see p. 502 this issue) at its Wilmington (Calif.) refinery.

. . . **Morton-Withers Chemical Co.** has received a certificate of necessity for a $1,780,742-project to make petroleum sulfonates for lube oil additives. Present indications are that the plant will probably be built in Texas. Company is now producing 25,000 lbs./day of sulfonates on a pilot plant scale at Greensboro, N. C.

Markets, Prices

. . . **Too much supply in the interior of the nation,** and not quite enough in coastal districts, characterized oil refinery markets in the month of March.

As in the recent past, supply was onerous with prices "shaded" and reduced at many refineries in the Mid-Continent, the Midwest and Chicago districts. On the other hand, Gulf Coast, East Coast and California refiners generally found buyers at firm prices. Gasoline and heavy fuel in the Gulf cargo market, however, appeared more plentifully available than in previous months of the year.

. . . **Threat of general refinery strikes** for a time tended to bolster demand in the Midwest. However, storage at most northern Mississippi terminals already was overstocked, and this impetus of demand lagged quickly.

On another front, it was touch and go at press-time whether the nation's steel mills would be halted by general strikes. Should strikes occur, the depressant effect on Midwestern bunker oil prices would be noticeable immediately, trade sources said.

. . . **Refined products price changes** were exclusively on the downside:

Mid-Continent natural gasoline prices were off 1.375c to 5.5c, FOB Group 3, and 5c, Breckenridge.

Oklahoma distillate quotations were generally off 0.125c per gal. to 8.875c for kerosine, 8c for No. 2 fuel, and 8.625c for Diesel, and heavy fuel off 5c to $1.45 per bbl.

LPG prices fell to "summer levels" on offerings of propane at 2.5c and butane at 3c, FOB Group 3.

Solvent bright stock, Tulsa basis, was offered at 33.5c, down 0.5c, and neutral oils generally were 1 to 2.25c lower.

Industrial Mobilization

. . . **Increased avgas output** has been urged by Deputy PAD Bruce K. Brown, declaring that "supply situation continues critical" and military has boosted April requirements. "If the industry is to meet the needs of all users during the next few months," he said, "production of aviation gasoline must be stepped up appreciably over current levels." One suggestion made was to reduce working stock levels.

. . . **Aviation alkylate production capacity** will be boosted by more than 27% to almost 200,000 b/d in near future, PAD predicted last month. Current capacity is 155,000 b/d, with 42,567 b/d due to be added by projects already under construction or for which priorities assistance on materials has been authorized for 2nd quarter.

. . . **Restrictions on TEL in motor fuel** were expected to be lifted by PAD this month—and may even have been by the time you read this. Decision is based on three factors: (1) TEL stockpile is apparently at level satisfactory to military, (2) Raw materials for TEL are now in adequate supply, and (3) New manufacturing capacity is expected to be in production soon. Although use restrictions will be lifted, PAD will keep Order No. 1 in force so as to continue receiving information on use and supplies.

. . . **PAD's controversial order No. 4,** requiring minimum of 4 cc. of TEL fluid in commercial aviation gasoline, may be lifted by late December. C. E. Davis, PAD's asst. deputy administrator for domestic operations, last month said that present indications are that "the supply position [of aviation gasoline] should be approximately in balance by the end of the third quarter of this year" and that the order could be rescinded at that time.

. . . **Plenty of steel will be available** for virtually all purposes next year, in the personal opinion of one Defense Production Administration official. One possible tight supply situation that might still exist, he thinks, is in pipe, particularly in large diameters, because of lack of sufficient pipe-producing facilities to meet increasing demands. He estimated that total steel products capacity next year would be 89 million tons, and that demands would be about 75 million tons.

. . . **Lead supply now appears adequate** to meet defense requirements and all normal needs of civilian economy, according to National Production Authority, which last month amended lead order M-38 to remove all end-use restrictions.

. . . **Sulfur and Sulfuric Acid** Orders M-69 and M-94, respectively, have been amended to require filing of new reporting forms by all consumers and suppliers of those two products. Each person using more than 20 short tons of sulfur in any calendar month must file monthly reports on Forms NPAF-157 and NPAF-158, with reports due by 15th of each month. Consumers of sulfuric acid must file monthly reports on NPAF-159, NPAF-160 and NPAF-161. Sulfur suppliers must report sales, production, imports, shipments and stocks with Bureau of Mines on B of M Forms 6-1230-M and 6-1238-M, with reports due on 10th of each month.

. . . **Phenol supplies are expected to tighten** up this summer, and National Production Authority is warning users to take advantage of present looseness in supplies and expand inventories now as much as possible. No easing in situation is expected for balance of year at least.

Transition

. . . **Sinclair Oil Corp.** has acquired Stoll Refining Co. of Louisville, which it will operate as a marketing subsidiary, retaining Stoll name. Property includes 1600 b/d lubricating oil and wax plant and 2000 b/d cracking plant at Louisville, latter idle for about two years.

There are many waterfalls but . . . *only one* Niagara

There are many coatings but . . . *only one* INSUL-MASTIC

INSUL-MASTIC pioneered heavy coatings—of *superior* quality. Years of thorough testing and experimentation, by corrosion plagued chemical companies, proved conclusively that long term protection against acids, alkalis and weather was at long last possible, through the use of INSUL-MASTIC.

The government confirmed this finding—INSUL-MASTIC being the only mastic coating ever approved under the original rigid specification for "mothballing" the war materiel.

INSUL-MASTIC *superior* coatings brought about changes in coating specifications throughout industry. The extremely long life and very low moisture vapor penetration rate of INSUL-MASTIC were the qualities that industry was seeking in its fight against corrosion and moisture penetration. The proven formulae which brought this enduring protection are patented and *cannot be duplicated* . . . there is only *one* INSUL-MASTIC.

Tests by the National Bureau of Standards and other impartial laboratories* prove the value of INSUL-MASTIC's basic ingredients for increasing coating life. Those ingredients are a maximum percentage of Gilsonite and *carefully* chosen mica and asbestos.

INSUL-MASTIC Vaporseal Coatings will prevent corrosion under severe chemical conditions, and will vaporseal insulation or building walls.

INSUL-MASTIC Type "D" Insulation will control condensation or prevent 65% of heat loss.

There is only *one* INSUL-MASTIC—Write for the name of our nearest licensee.

Think first of the coatings that last!

* *Names on request*

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How would YOU solve these two problems?

VISCOSITY CONTROL is important to Fuller Brush manufacture. Special sealing compound makes their handles stay put. It's applied by expensive equipment. If the equipment is started before the compound is fluid, the automatic machinery will be severely damaged. Now a low-cost Fenwal THERMOSWITCH thermostat prevents damage by starting the motor *only* when viscosity is right.

SPOILAGE FROM OVER-HEATING would prove costly to egg producers if water in Paden's Whirl-A-Way egg washer got too hot. Accurate temperature control, under extreme moisture conditions, was called for. Only a temperature-sensitive, adjustable, moisture-proofed Fenwal THERMOSWITCH thermostat installation met *all* the requirements at reasonable cost.

A FENWAL THERMOSWITCH CONTROL may solve your problem, too. Its external, single-metal shell expands or contracts instantly with temperature changes, making or breaking enclosed electrical contacts. Compact, highly resistant to shock and vibration, Fenwal THERMOSWITCH units have solved hundreds of problems where heat is a factor.

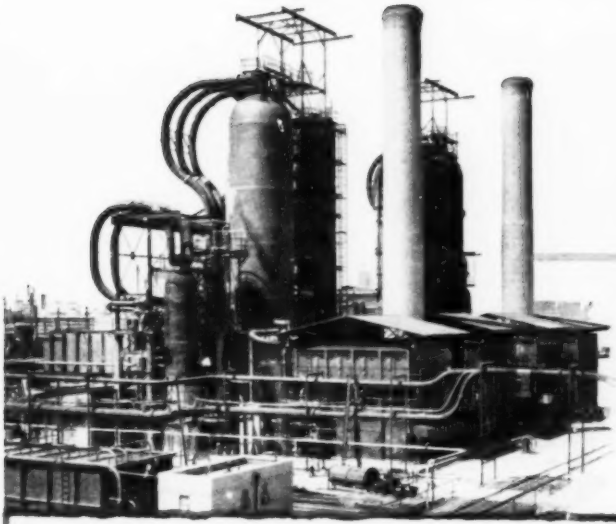
SEND FOR THIS NEW CATALOG for complete explanation of the unique THERMOSWITCH unit. Also ask for more detailed, illustrated discussions of the problems above. Fenwal engineers will be glad to help you solve your temperature control problems involving heat, humidity, vapor level, radiant heat, pressure and other variables. Write Fenwal, Incorporated, Temperature Control Engineers, 104 Pleasant Street, Ashland, Mass.

Fenwal

THERMOSWITCH®

Electrical Temperature Control and Detection Devices

SENSITIVE . . . *but only to heat*



Carey INSULATION

is at work for GULF . . .

keeping process and steam lines operating at lowest cost

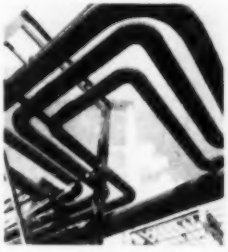
Refinery men demand *quality* insulation for processing operations. It's needed to keep fluids at constant temperatures. Helps cut fuel waste.

Since 1929, Carey insulation has been in continuous service at the Port Arthur, Texas plant of the Gulf Oil Corporation. Over the years, it has proven itself equal to the punishing strains of vibration and rapid expansion and contraction of equipment encountered in refinery operations . . . while guarding against heat loss, holding the line on costs!

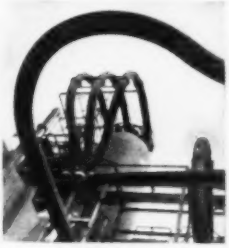
In *your* plant, you'll find dozens of applications where a Carey insulation material can conserve heat, save fuel. Carey's complete line of high and low temperature insulations includes blocks, blankets, pipe wrapping and jackets, cements and new Super-Light 85% magnesia in precision-sized blocks and nesting "O.D." pipe coverings that are easy and economical to apply.

Whether your problem is one of insulating "straight runs" or complicated shapes, a Carey Industrial Sales Engineer can show you why Carey insulation is best for the job. He'll gladly furnish you with complete technical and application data. No obligation to you. Telephone, wire or write our nearest office today.

Another Carey product—Careystone Corrugated Asbestos-Cement Roofing and Siding—protects Gulf Oil Corporation's warehouse at Port Arthur, Texas. This material is absolutely impervious to corrosion, rust, rot, decay; never requires painting or preservative treatment, virtually maintenance-free!



"Worm's eye" view of live and exhaust steam lines insulated with Carey materials. Besides the usual hazards of expansion, contraction and vibration, this Carey installation stands up under the extremely hot, humid weather of the Gulf area.



Carey insulation materials have weathered 23 years of continuous service on the fractionating tower and vapor lines of these atmospheric and vacuum stills at Gulf Oil Corporation's Port Arthur, Texas plant.

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of "Industrial Insulation." Tells all about Carey insulations, and how to select and use them. A copy is yours for the asking.

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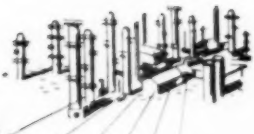
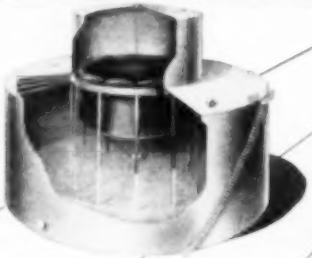
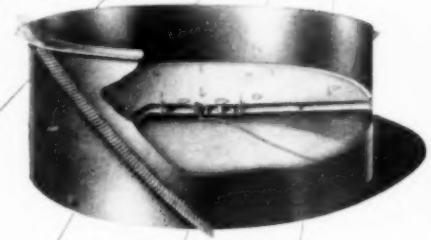
EXCLUSIVES

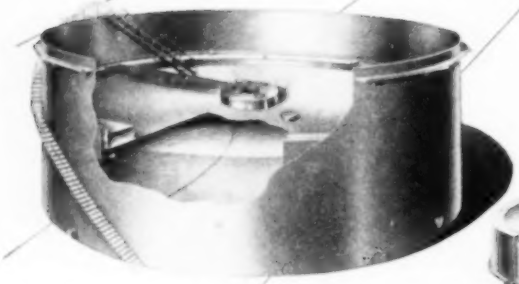




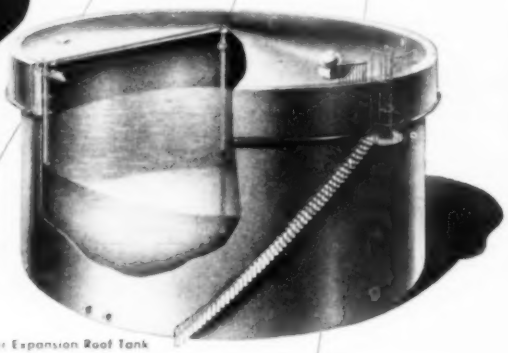
• Graver Vapor-Mizer



• Graver Double Deck Floating Roof Tank



• Graver Center-Weighted Floating Roof Tank



• Graver Expansion Roof Tank

These four Graver fabrications — each a patented design — are built not only to *conserve* but also to *preserve* the quality of the petroleum product. For this reason, the Graver principle of Conservation Control saves the volatile elements of gasoline, thus effecting economy and insuring motorists the same *high quality* that has been built into the motor fuel at the refinery!

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Want to Save Steel or Cut Costs? Try Loading Trucks at the Bottom

BOTTOM loading of oil tank trucks or transports, first reported as a trend of the times about a year and a half ago,[1, 2, 3] has now been demonstrated as a workable and practical reality by Standard Oil Co. (Indiana).[4]

A 16-month test run by the company at its Rochelle, Ill., pipe line terminal has convinced officials that the idea should and will be extended to other company facilities. Instead of a costly, space-consuming, hazardous, overhead loading rack which would require tons of hard-to-get steel, Indiana Standard's bottom loading unit consists of a simple meter, a short length of hose or pipe, and a dripless valve for connecting to the truck tank, all equipment being at ground level.

Five distinct benefits result from the new system: (1) installation costs are lower, (2) safety is improved—typical loading rack accidents are virtually eliminated, (3) vapor losses during loading are cut to an irreducible minimum, (4) ground space is conserved, and (5) loading facilities can be increased without making existing facilities obsolete.

The dripless valve design made the idea work. The valve has handles for quick manual connection to a simple loading nozzle adapter on the regular truck un-loading line. The valve is equipped with an interlock to prevent its being accidentally opened before being connected. It was developed from an earlier design used by the aviation industry for underwing loading of gasoline. Cost of equipping the truck with the adapter is small, about $40 to $50.

A loading facility is the same, whether it's at a pipe line terminal or in a refinery. Perhaps the day of the overhead loading rack is about done. —W.C.U.

(1) "Bottom Loading May Replace Overhead Racks in Plants" Petroleum Processing, May, 1951, p. 466.
(2) "Tank Truck Bottom Loading," *National Petroleum News*, Aug. 23, 1950, p. 39.
(3) "Ahead of the News," *National Petroleum News*, Oct. 25, 1950, p. 7; Dec. 27, 1950, p. 7; April 18, 1951, p. 7.
(4) "Bottom Loading of Oil Tank Trucks," *National Petroleum News*, Feb. 13, 1952, p. 17.

Petroleum, Chemical Industries Lead in Research Activities

OUT of all the manufacturing industry in the U. S., two branches—chemical and petroleum—lead the nation in research activities, according to figures compiled by the National Research Council.[1]

In 1950, oil companies had 17,065 research scientists and assistants on the payroll, better than 10% of the total of 165,000 research personnel of all manufacturing industries. In first place was the chemical industry, with 32,573 researchers. The rubber industry was a weak third, with 3,800.

It is not hard for the old timers in the oil industry to remember when precious little research was done, and the lab was in a sheet-iron shack with the apparatus oftentimes on a wooden packing box. In 1927 the oil industry had only about 800 research personnel on its payrolls, but in the past 10 years has added workers at the rate of 1000 per year.[2]

Putting it another way, in 1927 there were only 33 research workers per 10,000 employees in the oil industry. By 1937 this jumped to 200, and by 1950 to 300. For all manufacturing operations there were 130 per 10,000 in 1950, and in the chemical industry, 600 per 10,000.

It is very significant proof to the well known slogan that the oil industry is "progressive." The growth curve of research personnel in the oil industry still continues upward, although the expenditure per $1 of gross income is tending to flatten out. In fact, the oil industry curve of research personnel per 10,000 production workers already has passed the chemical industry, and is far above all others.

There is no doubt that the outbreak of World War II did much to increase the oil industry's research program, but the trend in that direction actually began around 1937, when many of the newer processes were conceived and developed. Now that the oil industry has most definitely entered the chemical manufacturing field, there is every reason to expect this trend to continue, although probably not at the same high rate as in the past. —D.P.T.

(1) "Industrial Research Laboratories of the United States," Bull. No. 120, National Research Council, 6th Ed., 1950.
(2) "Research: Who, Where, How Much," *Chemical Week*, Oct. 27, 1951, pp. 17-24.

Bureau Whittles Down Cost Estimate For Coal Hydrogenation Plant

THE Bureau of Mines has come up with a new estimate of the investment cost for a coal hydrogenation plant, on a selected site at Lake De Smet, near Sheridan, Wyo.[1] This current cost estimate of the capital requirement is $174,500,000 for a 15,000 b/d plant. The cost estimate for coal hydrogenation reported by the Bureau last October was $111,440,000 for a 30,000-bbl. plant at Rock Springs, Wyo.[2]

The detailed estimates are not directly comparable because of the difference in proposed capacity, among other factors. Among the process improvements listed as reducing the investment cost required for coal hydrogenation however is a "novel ash and unconverted coal disposal system," which provides greater converter capacity. "This involves the direct gasification of the heavy oil let-down from the hot catchpot for the production of the required hydrogen. Thus, the conventional means of heavy oil work-up, such as flash distillation or coking units, are eliminated completely and the coal gasification unit is greatly simplified as the feed material in this case is a liquid rather than fine divided solids, thus reducing the cost of the gasification unit. This feature of the process also simplifies other operations." The cost of the hydrogen purification and compression unit for the 15,000-bbl. plant is listed as $17,100,000, while the figure for that item in the estimate for the 30,000-bbl. plant is nearly $58,000,000.

Demonstration plant experience has proved, it is stated, that extremely pure hydrogen is not required for the process. This fact eliminated the need for carbon monoxide scrubbing facilities in the hydrogen manufacturing and purification portion of the plant. It had previously been assumed that CO concentrations in excess of 0.3% would result in unstable operation of the vapor-phase unit. However, vapor-phase operations in the demonstration plant were

found to be steady and apparently unaffected when using make-up gas containing 1 to 1.5% CO.

A Platformer unit has been included in the new proposed operation to enhance the value of products.

The estimate for the Lake De Smet operation is based on certain natural advantages provided by the selected site, which would hardly seem to make the figures typical for the cost of 15,000 b/d coal hydrogenation operations. These include strip mining the coal at an estimated delivered cost of 75c per ton to the plant and the use of sufficient water from a nearby lake to warrant the use of once-through cooling, thus eliminating the need for cooling towers.

—V.B.G.

(1) "Process in Coal Hydrogenation," by L. P. Skinner, Chemical Engineer, Synthetic Fuels Demonstration Plant, Fuels Technology Division, Louisiana, Mo., before American Institute of Mining and Metallurgical Engineers, New York, Feb. 18-21, 1952.
(2) "Cost Estimate for Coal Hydrogenation," U. S. Department of the Interior, Bureau of Mines, October 26, 1951.

Those Mechanical Octanes again -- They May Still Help Regular Gasoline

MANY refiners, if not most, take a rather dim view of the trends in automobile engine design toward more powerful motors through higher and higher compression ratios. While such motors are good performers with efficient fuel consumption, generally speaking, they require higher and higher octane rated fuels, more costly to manufacture.

Automotive engineers, however, have another avenue of approach to increased efficiency and performance—that of so-called volumetric efficiency, by means of the hemispherical combustion chamber engine. Chrysler's new "Firepower" and "Firedome" engines are of this design.

Some of the reasoning behind the development of this motor was discussed recently by James C. Zeder, vice president and director of engineering and research for Chrysler, and a past-president of the Society of Automotive Engineers.[1] The spherical segment combustion chamber is not new, he explained. Its history began in this country in 1904 when the Welch passenger car engine was produced. It has been used successfully in racing cars since that time: Stutz, Duesenberg, Miller, and Offenhauser for example.

Why has it not been more generally accepted as a passenger car engine? The answer is not simple, Mr. Zeder explained, but the two most important factors are: (1) the chamber early acquired an unenviable reputation due to its alleged roughness and fiscal appetite for high-grade fuels; and (2) its complexity and cost, as usually constructed, gave little promise of its adaptability to high production.

Chrysler feels it has overcome these problems in its approach to efficiency through mechanical, rather than chemical, thinking. Their tests show, according to Mr. Zeder, that a V-8 engine with the hemispherical combustion chambers and multiple carburetion gives up to 309 hp. with premium-grade gasoline. Using 125 octane fuel, the hp. goes up to 353. He believes this indicates an ability to assimilate and profit by better fuels when they become available; yet at the same time an ability to do a good job with existing fuels.

Just exactly what kind of motor fuels the future will require the petroleum industry to process is still a crystal-ball proposition. But the success of the spherical segment combustion chamber design is at least one factor that throws a little more light into the crystal ball.

—W.C.U.

(1) "New Horizons in Engine Development," James C. Zeder, Chrysler Corp., presented at S.A.E. National Passenger Car, Body, and Materials Meeting, Detroit, Mich., March 4-6, 1952.

Canada's Alberta Tar Sands Due for Further Exploration

THE current interest in Canada's petroleum and gas resources is also taking in the Athabasca tar sands in northeastern Alberta province, 250 miles by pipeline from Edmonton, and undoubtedly a tremendous reservoir of heavy oil, in the form of bitumen mixed with sand. The reserve, it is said, may amount to as much as 300 billion barrels, in beds of sand 100 to 150 feet thick, over an area variously estimated at from 8000 to 30,000 square miles.

N. E. Tanner, Alberta Minister of Mines and Minerals, has stated[1] that five Canadian companies have taken out leases in the area totaling 250,000 acres and have paid in $250,000 to guarantee carrying out their program. It is also announced the Swedish Shale Oil Co. has arranged with the Canadian government to carry on work there on a special development process. The conservative arrangements of the Canadian authorities provide for issuing prospecting permits, with the exploratory work to be completed in three years. Leases to mine the sand and extract the oil run for 21 years but call for construction of a recovery plant to be started within two years and to be in operation within five years of the granting of the lease.

The existence of the Athabasca tar sands has been known since 1788 and various theories have been advanced for the presence of the oil in its present form. Some hold that the oil escaped into the overlying sands from fractures and fissures in lower geologic structures and that, if so, there must remain sizeable reserves under the present sand beds. The Research Council of Alberta in 1920 started its investigations of means for recovery of the oil from the sands. Because of the nature of the bitumen deposits on the sand particles, hot water washing of the sand was first considered to offer greatest promise for recovery. Freshly mined Alberta sand is said to contain 2 to 5% water and 10 to 17% oil, the balance being mineral matter. Two private companies installed hot water separation plants, one being the Abasand Oils Ltd., head of which was Max W. Ball, well known petroleum technologist, and at one time Director of the Oil and Gas Division of the Interior Department.

Recently a different approach to the recovery of the oil from the sand has been developed, as was described at the Athabasca Oil Sands Conference in Edmonton last September, sponsored by the Alberta provincial government.[2] This is a fluidized solids technique in which the oil is continuously extracted from the fresh bituminous sand by a moving bed of hot spent sand in the still bed.

Without question there are very large reserves of oil in the Alberta tar sands. As compared with the manner in which our own oil shales have been exploited, it is encouraging to note the conservative way the Canadian authorities are proceeding to bring the development in Athabasca to the commercial stage.

—V.B.G.

(1) *New York Times*, March 17, 1952.
(2) *Proceedings*, Athabasca Oil Sands Conference, Board of Trustees Oil Sands Project, Government of Alberta, Edmonton, Canada.

How to put HD into premium lubricants

Short-trip, stop-and-go driving, the kind of driving most passenger cars get, results in (1) dirty engines and (2) high engine wear. These, in turn, result in several poor-performance factors easily recognized by motorists — high oil consumption, hydraulic valve lifter sticking, general shortening of engine life.

Monsanto Santolube 382 and Santolube 388 will help give your oils the performance demanded by today's passenger cars. These heavy-duty, detergent-inhibitor type additives help keep engines clean, help reduce engine wear.

For technical information on these efficient Santolubes, write MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second Street, St. Louis 4, Missouri.

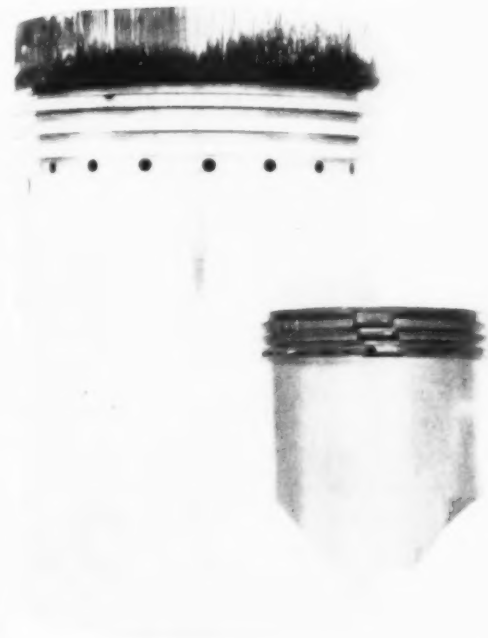
Santolube Reg. U. S. Pat. Off.

SANTOLUBE

MONSANTO
CHEMICALS — PLASTICS

SERVING INDUSTRY . . . WHICH SERVES MANKIND

Upper photo shows diesel and passenger car pistons after engine tests with a good grade of motor lubricating oils. Bottom picture shows results of tests on the same oils, plus Monsanto detergent-inhibitor additives.



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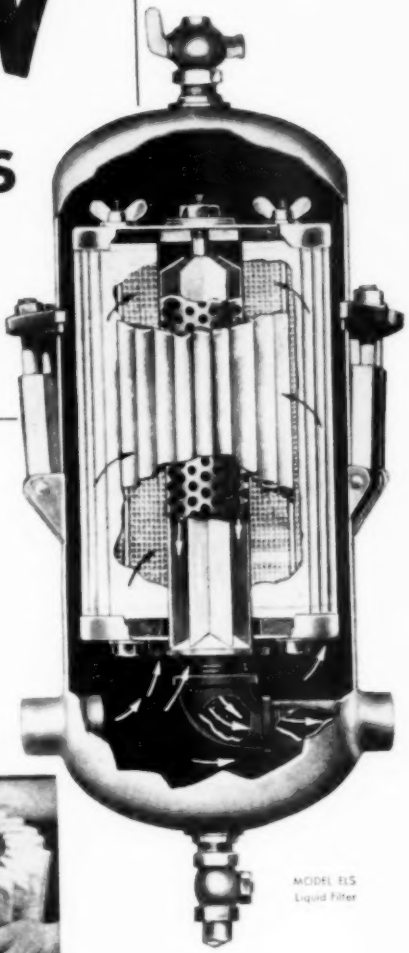

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Bring your liquid filtration problems to Dollinger engineers. Their specialized experience is available in recommending the most efficient and economical equipment for filtering liquids in a wide range of viscosities, temperatures, acidities, alkalinities, pressures and capacities.

Staynew exclusive design, permits use of *any medium in sheet form that can be crimped.* Metal, plastic, fabric, ceramic and metallic mesh media can be used for super-fine filtration.

Write us today outlining your specific liquid filtration problem. From our 30 years experience in liquid filtration, we have built up a vast file of helpful information. Any part of this information is yours for the asking—no obligation.

Staynew Radial Fin Construction provides the largest possible filtering area for available space. Slip-On Insert exclusive in Staynew Filters permits simple, inexpensive cleaning or replacement of media.

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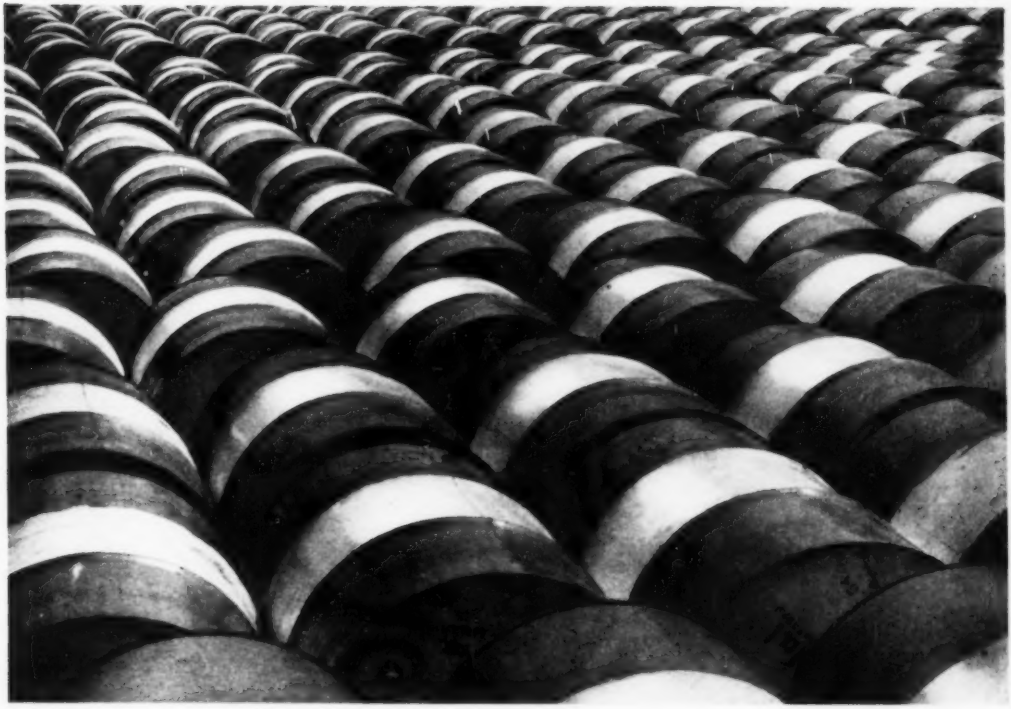


A cool 7800 barrels a day!

Cit-Con Oil Corporation's Lake Charles, La., plant is the largest in the world built exclusively for manufacturing of lube oil. Though rated capacity is 6000 barrels per day, it is actually running at 7800 bpd!

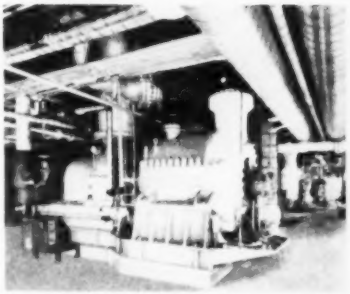
To produce this low pour point oil, Cit-Con uses two MEK dewaxing units equipped with 1165-ton Worthington Centrifugal Propane Compressors, with a standby compressor of the same capacity. The installation also includes 14 Worthington double pipe exchangers, 12 inclined direct expansion chillers, and 6 vacuum pumps.

Cit-Con is one of a large number of "big names" that have selected Worthington refrigeration. Others include: Esso Standard Oil Co., Bayonne, N. J., and Baton Rouge, La.; E. I. DuPont de Nemours & Co., Edgemore, Del., Orange, Tex.; Shell Chemical Corporation, Houston, Tex.; Socony-Vacuum Oil Co. Inc., Paulsboro, N. J., The Pure Oil Co., Smith's Bluff, Tex.; Standard Oil Co., Richmond Cal.; Sinclair Refining Co., Houston, Tex.; Tidewater Oil Co., Bayonne, N. J.

Important companies with world-wide reputations like these don't install *any* equipment on a haphazard basis. The fact that they've chosen Worthington refrigeration equipment is the best testimony we have for the conclusion: *there's more worth in Worthington.*

No other manufacturer makes so complete a line. And a Worthington system is Worthington-*made*—not just Worthington-assembled, assuring you of perfectly balanced operation and unit responsibility.

Worthington Pump and Machinery Corporation, Air Conditioning and Refrigeration Division, Harrison, N. J.

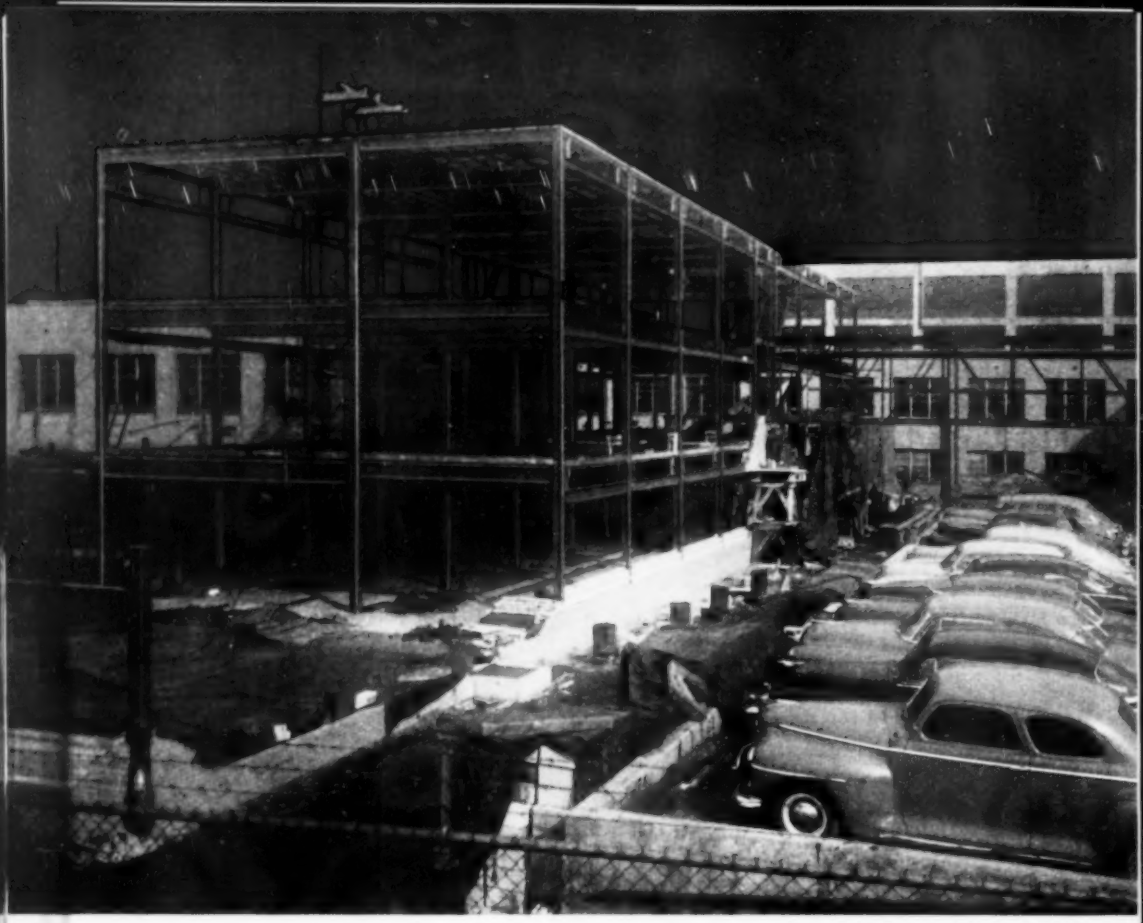


WORTHINGTON CENTRIFUGAL PROPANE COMPRESSORS at Cit-Con Oil Corporation's Lake Charles, La., plant. Engineer and Contractor: The Lummus Co., New York, N. Y.

A-1-44

WORTHINGTON

Air Conditioning and Refrigeration



Another expansion OF McKEE DESIGN, ENGINEERING AND CONSTRUCTION FACILITIES

This new wing will add approximately 26,000 square feet of space to the McKee Building — space for further enlargement of our engineering staff.

Expansion is not new at McKee. The addition you see under construction is the third enlargement of our Cleveland headquarters, the seventh increase in engineering space here and in other cities since 1939.

This is no mushroom growth. It is part of a steady expansion program with future additions already planned to keep pace with increasing demands for McKee engineering services.

DESIGN, ENGINEERING AND CONSTRUCTION FOR THE PETROLEUM REFINING AND IRON AND STEEL INDUSTRIES

McKee Engineering

Arthur G. McKee & Company · Established 1905

Headquarters: McKee Building, 1300 Chester Avenue, Cleveland 1, Ohio
New York Office: 30 Rockefeller Plaza, New York 20, N.Y. · *Washington Office:* Otis M. Smith Jr., Washington, D.C. · *England:* Arthur G. McKee & Company (Overseas) Limited, London
Arthur G. McKee & Company is represented by Hunt, Wenzel & Company, Ltd.
District Engineering Offices: Houston, New Jersey and Tulsa, Oklahoma

Letters

Wax Crystallization

Thank you for the excellent handling and publishing of my article on wax crystallization [March, p. 326].

. . . The layout of the paper was very satisfactory, but I would like to call your attention to the following items which may confuse some of the readers:

1—In Fig. 3, the picture listed as "Fraction 14, 450 Magnification, Partially Polarized Light" should be the special 11F.2" M.P. plates and vice versa.

2—In Fig. 6, the pictures listed "in Toluene" should be "in MEK/TOL" and those listed "in MEK/TOL" should be "in Naphtha."

3—In Table 8, the melting point should have been 108.5° rather than 18.5°.

HAL A. LUND
Magnolia Refining Co.
Beaumont, Texas

Eclipse of Research

I have read with considerable interest your editorial in the February, 1952 issue of PETROLEUM PROCESSING entitled "The Eclipse of Industrial Research."

You are completely correct in stating that the Defense Department has moved into the industrial research picture with great severity. It becomes increasingly difficult for the average company to hire good men, purchase equipment, and to meet competitive salaries. . .

My specific purpose in writing is to congratulate you on such a forthright editorial, and to point out to you that here at Midwest Research Institute, which, as you may know, is a nonprofit organization founded in 1943 to do industrial research, we make it a definite point to stress the value of research to industry. While we have government programs, we do only that research which we feel is necessary to make our contribution to national security. In the meantime, our industrial programs continue to grow. We . . .[are] able to undertake new programs from industrial organizations which, by virtue of the facts you have pointed out, are unable to meet their own research demands.

I mention the above merely to indicate that the cause is not lost for industrial research, and that organizations such as ours, and half a dozen similar ones throughout the country, are making a determined effort to assist industry on a broad research front.

C. N. KIMBALL
President
Midwest Research Institute
Kansas City, Mo.

Why Good Pipe Fitters Choose

RIDGID

4P Geared Pipe Threader

No. 4P, 2½" to 4" pipe

Extra easy to carry and put on pipe

★ Balanced loop handles—easy to swing 4P where you want it.

★ Mistake-proof workholder sets to size *before* put on pipe—only one set screw.

★ Practically no upkeep—drive pinion in oilless bronze bearing; safe enclosed gear.

★ 4 sets of 5 high-speed steel dies for 2½", 3", 3½", 4" pipe. Ratchet handle; RIDGID Universal Drive Shaft available. Also special 4P for conduit.

★ Buy efficient 4P at your Supply House.

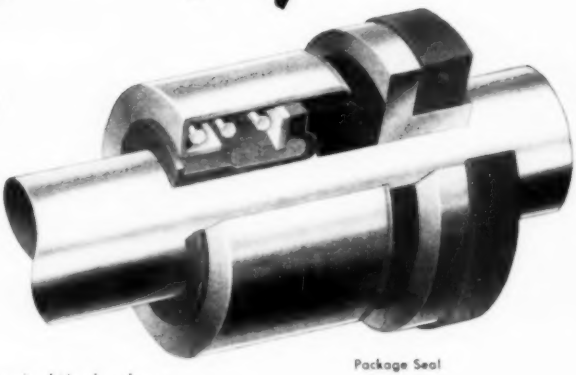
THE RIDGE TOOL COMPANY • ELYRIA, OHIO

★ ★ ★ RIDGID Work-Saver Pipe Tools ★ ★ ★

(To obtain more data on advertised products see page 552)

Garlock Mechanical Seals Save 3 Ways!

1. **REDUCE LEAKAGE OF COSTLY OR HAZARDOUS LIQUIDS ON ROTATING SHAFTS**
2. **NO WEAR ON SHAFT OR SHAFT SLEEVE**
3. **LONG LIFE WITH LESS PRODUCTION LOSS AND LOWER REPAIR COST**



Package Seal

It is most economical to use Garlock Mechanical Seals whenever *leakless* operation of rotary shafts on pumps or other equipment is required.

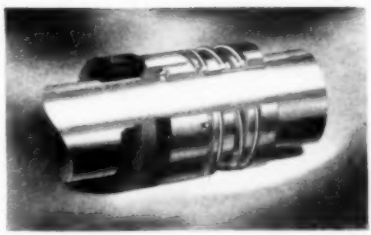
Once the proper Garlock Mechanical Seal has been installed on a rotary shaft you can forget about leakage. A leakless seal is provided by a positive contact between carefully lapped metal-to-carbon or metal-to-metal mating surfaces.

Garlock Mechanical Seals are recommended for use on rotating shafts against practically any liquid including strong acids. All metal parts are available in a variety of corrosion-resistant materials.

The CHEVRON* Seal, for pressures up to 200 p.s.i., and the "O" Ring Seal, for pressures up to 1000 p.s.i. and over, are individually engineered for each application.

The Package Seal is a low-cost, production-run seal for pressures up to 150 p.s.i. Package Seals of standard construction (brass case and brass washer) are stocked at the factory, for shafts size ⅜" to 2", advancing by sixteenths, and for shafts size 2" to 3", advancing by eighths.

For complete information write for our Mechanical Seal Booklet or ask your Garlock representative.



CHEVRON* Seal

"O" Ring Seal

*REGISTERED TRADEMARK

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
Tulsa, Okla. Houston, Tex.
Los Angeles, Calif.

GARLOCK

PACKINGS, GASKETS, OIL SEALS, MECHANICAL SEALS

It took 60 years to save three months

on Socony's new cat-cracker*

The cat-cracker, the most important processing unit in a refinery today, is usually built from the ground up like a skyscraper—one or two floors at a time. But Fluor has developed a new time-saving technique of designing the component parts so that they can be fabricated on the ground simultaneously and lifted into place, thereby making more efficient use of manpower and equipment. Construction crews work in perfect coordination on a production-line basis to effect substantial savings in construction costs, but above all in *time!*

Fluor designed and constructed the catalytic cracking unit shown here for Socony-Vacuum at Augusta, Kansas. It stands 268 feet high, equivalent to a 22-story building. Nine months and 13 days after foundation was poured, it went on stream for 15,000 barrels a day, three months earlier than could be normally expected if built by conventional methods under similar circumstances. This airlift TCC unit processes about 1½ million barrels of oil in three months, that's why getting it into operation in the shortest possible time was an all-important objective.

*Thermofor moving-bed catalytic cracking unit built for Socony-Vacuum Oil Company at their Augusta, Kansas refinery

First, an experimental model was built to scale to check basic rigging design, to study actual erection problems, and to locate the most efficient work and storage areas before starting work in the field. The unit stood 53½ feet high.

Here's how it was done— from conception to *Completion*

October 26

Reinforced concrete was used to a height of 100 feet for fire protection. While the base was being poured (August 21, 1950), these concrete panels weighing 85 tons each were being cast on the ground slab.

December 22

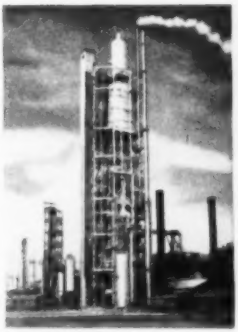
In spite of sub-zero weather, the building marathon continues. The Reactor weighing 100 tons is being hoisted 100 feet into the air. It took less than an hour to complete this operation. The cracking process takes place in this unit.

January 4

This steel section, assembled on the ground and weighing 110 tons, was lifted 160 feet and lowered into place over the Reactor. It supports the Hot Catalyst Bin. This is one of 28 major lifts varying in weight from 60 to 125 tons.

March 5

After the last steel section was set, the Separator Surge Drum (63 tons) is raised into place on top. This was the last lift to be made. Total height is now 268 feet, 22 stories high, and is one of the tallest structures in Kansas.



May 10

Operation testing completed and ready for start up, 9 months and 13 days after foundation was finished. This cat-cracker is capable of processing 630,000 gallons of oil every day. Fluor has four more similar units under way.

For 60 years Fluor has been building for industry and is among the leaders in plant construction for the oil, gasoline, chemical and power industries in and out of the continental United States. If time-saving is your concern, take time to contact your nearest Fluor district office for details. Write for Bulletin CC2521 describing Fluor activity in the construction of Fluid and Thermofor cat-crackers.

FLUOR

Engineers - Constructors - Manufacturers

THE FLUOR CORPORATION, LTD., 2500 S. ATLANTIC BLVD., LOS ANGELES 22, CALIF.
New York, Chicago, Pittsburgh, Tulsa, Houston, San Francisco

Represented in the Sterling area by:
Head Wrightson Processes Ltd., Teesdale House, Baltic Street, London, E.C.1., England

(*To obtain more data on advertised products see page 552*)

AUTOMATIC CONTROL EQUIPMENT

ENGINEERED DESIGN BY **HAMMEL-DAHL**

Announcing a 2nd New and Modern

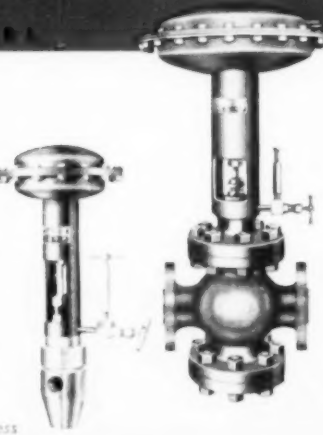
HAMMEL-DAHL OFFICE and FACTORY

PLANT No. 3
General Office and Factory
175 Post Road, (Warwick) Providence 5, R. I.

OUTSTANDING ENGINEERING AND PRECISION WORKMANSHIP

Constantly increasing demand from ALL of the PROCESS INDUSTRIES for more HAMMEL-DAHL Control Valves, embodying these basic qualities, has made necessary the construction of this new, larger, modern plant. It is equipped throughout with machine tools of the latest design, production equipment, assembly and testing fixtures.

This expansion means faster deliveries, superior service and better attention to each and every customer's requirements.



Consult your nearest H-D Sales Engineer for Precision Control of your Process

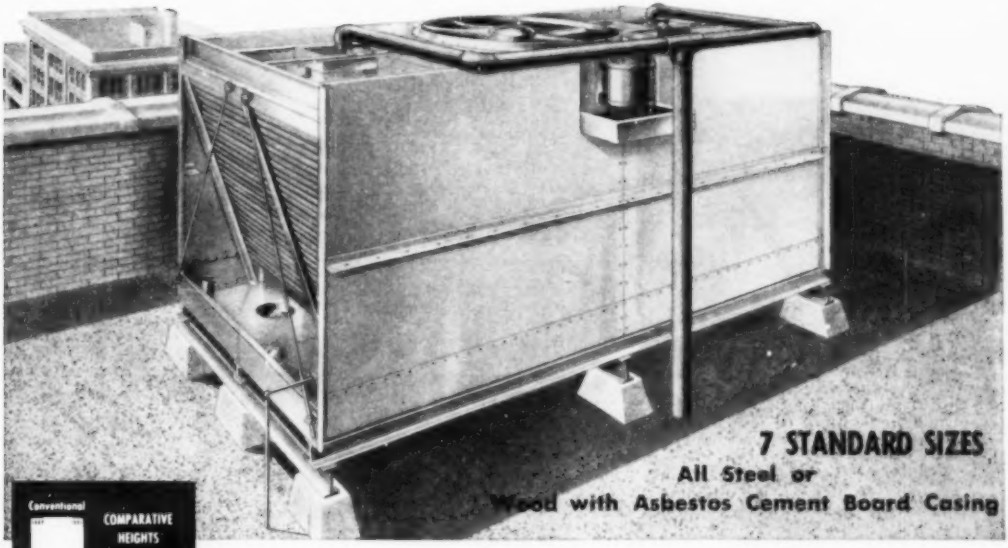
HAMMEL-DAHL COMPANY

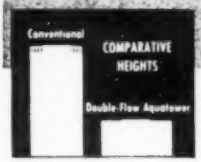
175 POST ROAD, (WARWICK) PROVIDENCE 5, R. I., U. S. A.

Albany Boston Buffalo Chicago Cincinnati Cleveland Denver Detroit Houston Kalamazoo
Kansas City Kingsport, Tenn. Los Angeles New Orleans New York Pittsburgh Salt Lake City
San Francisco Seattle Springfield, Mass. St. Louis Syracuse Toledo Tulsa Wilmington, Del.

NEW DOUBLE-FLOW AQUATOWER

Marley Introduces Lowest Silhouette, Lowest Pumping Head Cooling Towers For Intermediate Capacities





New Simplicity • New Accessibility • New Efficiency

By combining the outstanding features of the large patented Double-Flow and the smaller Aquatower (both accepted leaders in their fields), Marley has produced the cooling tower that will set the standard in another size range . . . THE DOUBLE-FLOW AQUATOWER. Architects, engineers and contractors will be equally enthusiastic about this tower because it is highly efficient, lowest in height and harmonious with building design, and remarkably easy to erect.

The Double-Flow design means low tower height and low pumping head; efficient air utilization—one fan drawing air from two completely open sides—with consequent minimum fan horsepower requirement. Open distribution, "at-a-glance" inspection are features, as are minimum load concentration and economical grillage and support.

From the Aquatower comes simplicity . . . of construction, of piping, of operation. The nailless Redwood filling that is very easily installed or removed is another adaptation. All basin fixtures are readily at hand. Double-Flow Aquatower mechanical equipment is all designed, manufactured and guaranteed by Marley specifically for cooling tower usage . . . and it is all completely accessible.

You'll want complete details of this tower that will fit many installations in many industries, typical of which are those requiring 50 tons or more of refrigeration. Fill out the coupon below and you will receive it immediately.

Producers of
DOUBLE-FLOW TOWERS
AQUATOWERS
VAIRFLO TOWERS
CONVENTIONAL TOWERS
DRICOOLERS
NATURAL DRAFT TOWERS
SPRAY NOZZLES

MARLEY

The Marley Company, Inc.
222 West Gregory, Kansas City 5, Mo.

Send me your 8-page brochure on the new Marley DOUBLE-FLOW AQUATOWER.

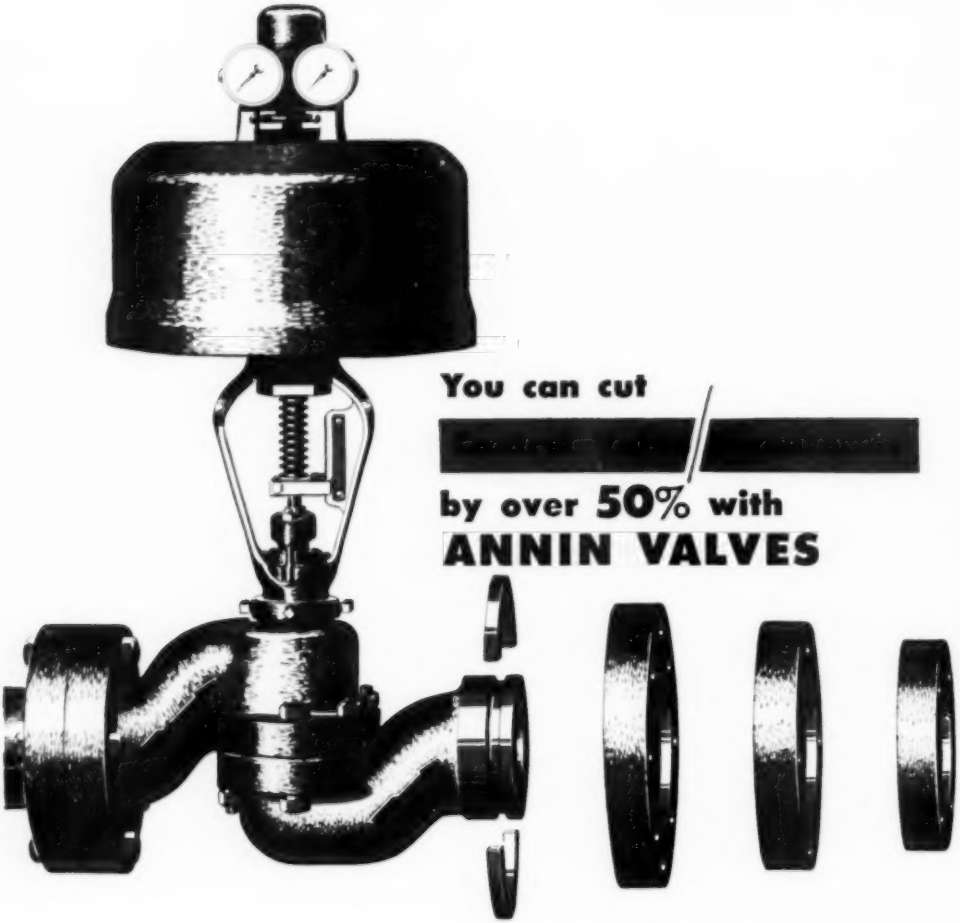
Name _____

Firm _____

Address _____

City _____ State _____

Protected by Marley Double-Flow Patents



You can cut

[redacted]

by over 50% with

ANNIN VALVES

Designed for maximum interchangeability of valve bodies, flanges and operators

The Annin Domotor valves provide positive control of corrosive, erosive fluids and fluids containing semi-solids.

Because all Annin valve bodies carry 1000 # ratings, interchangeable flanges in Series 15, 30 and 60 can be mounted with split-rings on any Annin valve body to meet the requirements of practically any installation. One body, mounted with proper flanges, can be used anywhere in the plant. In addition, any Annin operator—Domotor, Electro-Pneumatic, Handwheel—fits *two* sizes of any valve body. Thus it is unnecessary to stock spares for *every* valve type and size you use. Most Annin users report great reductions in necessary valve stocks from 50% to 75% and more!

This reduction in inventory, *plus* considerable reductions in maintenance costs make the Annin Valve one of the most economical to operate in your plant. It will pay you to investigate today the many advantages of Annin Control Valves. Send for Catalog 1500B.

ANNIN VALVES

Annin Catalog 1500B describes all Annin Valves, tells how Annins reduce inventories and cut maintenance costs. Send for your copy *today!*

[redacted]

HERE'S A GOOD COMBINATION FOR High-Temperature Bolting

When you encounter particularly tough bolting conditions in high-temperature, high-pressure service, use the Bethlehem Continuous-Thread Stud, together with two Bethlehem Quenched Nuts. This combination of fasteners is economical because it resists creep and premature failure induced by high temperatures and pressures, and therefore helps to minimize down-time.

BETHLEHEM CONTINUOUS-THREAD STUD—This stud is ideal for difficult bolting jobs because it minimizes stress concentrations. Has no point of thread runout. Consequently, stresses cannot concentrate at any given point to cause premature failure. Instead, the stresses are well distributed over the entire working length of the stud.

BETHLEHEM QUENCHED NUT—A forged nut, made from high-quality 40-to-50 carbon steel. After forging, the nut undergoes controlled quenching and tempering, arming it with sufficient strength to develop the strength of any stud or bolt on which it is used.

WIDE SIZE RANGE

The Bethlehem Continuous-Thread Stud and the Bethlehem Quenched Nut are made in a wide size range. They make a good combination—one which you can use with complete assurance that it will do the job. Full details from the nearest Bethlehem office.

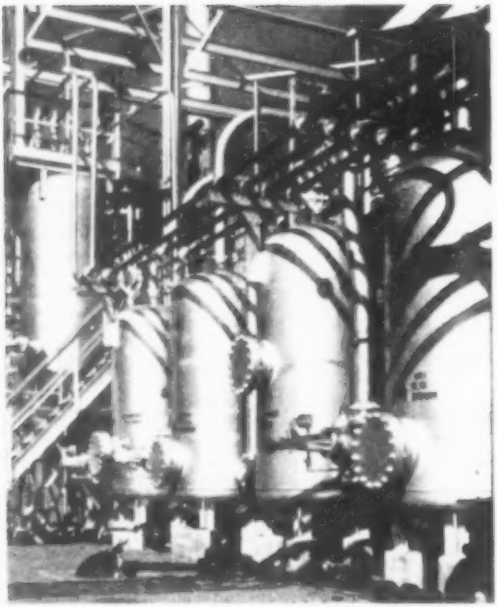
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

Bethlehem supplies every type of Fastener

NEED these Quality Products for Petroleum Processing?



- ✓ SODA ASH
- ✓ CAUSTIC SODA
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- ✓ CALCIUM CHLORIDE
- ✓ SODIUM NITRITE

Get them from SOLVAY

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Alkalies ⚓ Chemicals
Since 1881

Soda Ash · Caustic Soda · Caustic Potash · Nytron · Chlorine · Calcium Chloride · Potassium Carbonate · Sodium Bicarbonate · Formaldehyde · Specialty Cleansers · Ammonium Bicarbonate · Sodium Nitrite · Para-dichlorobenzene · Ortho-dichlorobenzene · Monochlorobenzene · Ammonium Chloride · Methanol

Want to be certain of quality and uniformity in the chemicals you use for processing operations? Make sure you get them from SOLVAY—America's leading producer of alkalies and associated chemicals! You can also depend on SOLVAY for *service*—for helpful *sales* service from thirteen sales offices and a nationwide chain of distributors; for *delivery service* from centrally-located plants and over 200 coast-to-coast stock points; and for an exclusive Technical Service for the petroleum industry.

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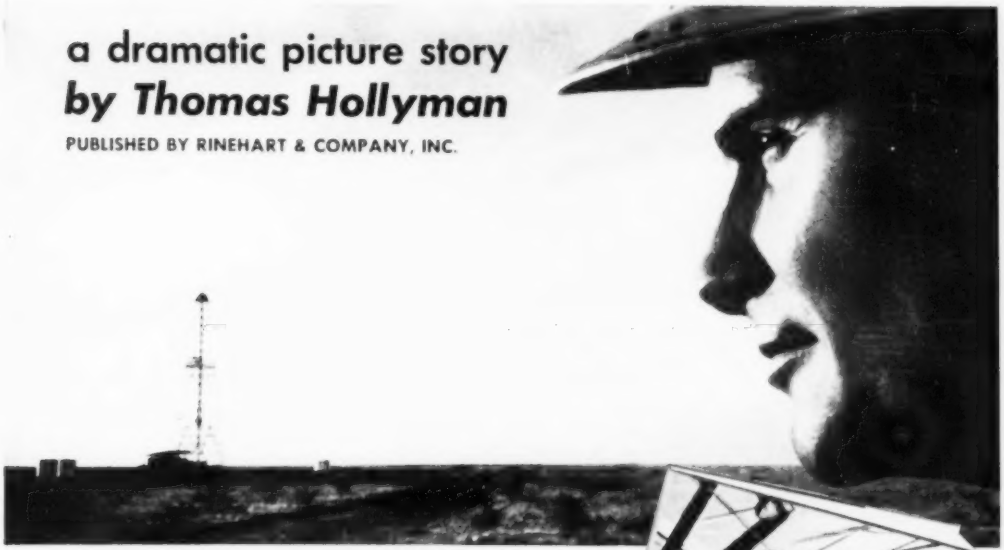
It's your industry . . . It's your story . . . It's the book for you . . .

"The Oilmen"

a dramatic picture story *by Thomas Hollyman*

PUBLISHED BY RINEHART & COMPANY, INC.



It's a book you'll use hundreds of times —the picture story that captures the personality of an industry

● Consulting photographic editor of *Holiday*, and a contributor to other top magazines, Tom Hollyman now turns his lens on *oil*—to tell its exciting story in terms of the industry's men and women.

Dramatically photographed, concisely written, clothbound and oversize, "The Oilmen" tells petroleum's full story from search to discovery...through production, refining, transportation, marketing... to the ultimate user's door. It's a book the industry has needed for years, a book that every man and woman associated with petroleum must see, read, own.

$1.50 ACTUAL SIZE 10⅛" x 10½"

Shell Oil Company and its employees co-operated with Mr. Hollyman to make this picture story possible—and offer this announcement as a service to the men and women who have made oil the nation's No. 1 source of energy.

"The Oilmen," published by Rinehart & Company, Inc.
First Edition available May 1, 1952

AT ALL LEADING BOOK STORES—OR SEND COUPON

Rinehart & Company, Inc., Dept. 2
232 Madison Avenue, New York 16, New York

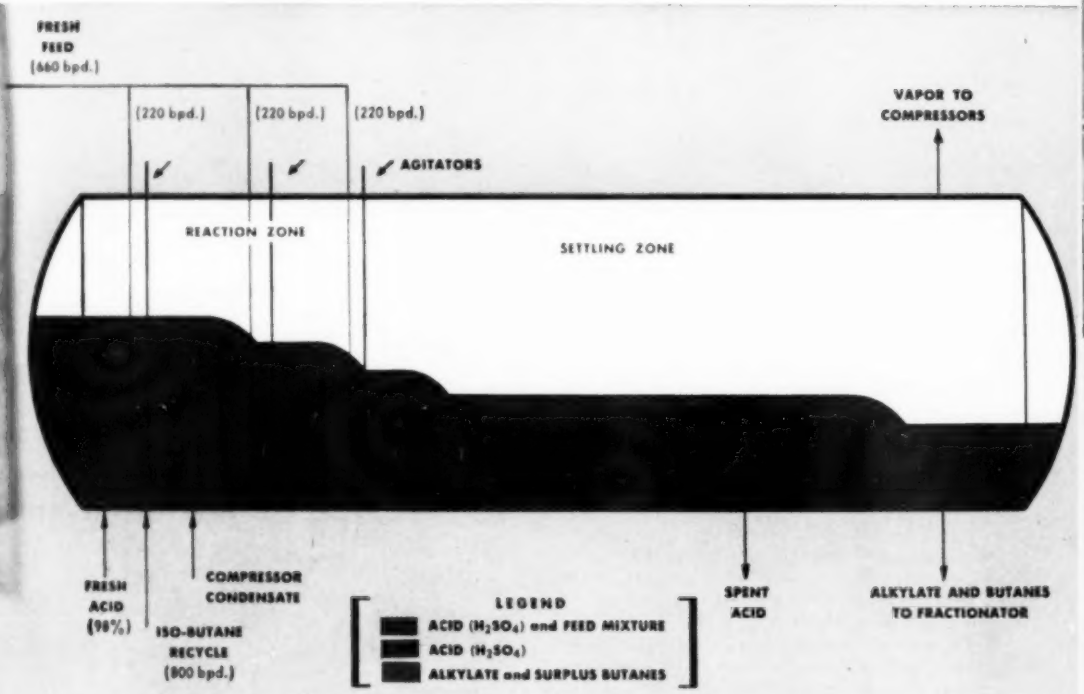
Please send me ____ copies of THE OILMEN @ $1.50.
I enclose check or money order in the amount of $ ____

Name _____

Address _____

_____

This NEW Kellogg-cascade reactor initial cost



How New Reactor Maintains 9-to-1 Isobutane-Butylene Ratio

Assume, as a simplified case, that fresh feed is charged to the reactor shown here at 660 barrels per day. This feed, comprising a mixture of approximately 300 barrels of butylene and 360 barrels of isobutane, is divided into three equal 220 BPD portions, each of which is introduced into one of the three reaction sections.

To increase the amount of isobutane at the points of reaction, a recycle stream of isobutane from the unit's main fractionator is fed in at the bottom of the first section. This recycle must be at a rate of 800 BPD to provide the desired isobutane-butylene ratio.

Adding up the total amount of isobutane in the first reaction section, we find there are 920 barrels to 100 barrels of olefin. Since only about 110 barrels of the isobutane reacts with the total olefin present, about 810 barrels of excess isobutane are carried over into the second section where the cycle starts over again.

Thus, while the total amount of olefin charged each day to this reactor is 300 barrels and the total amount of isobutane is 1160 barrels (a ratio of about four-to-one), the actual ratio at all reaction points is better than *nine-to-one*.

(To obtain more data on advertised products see page 552)

designed brings lower to sulphuric acid Alkylation...

SULPHURIC ACID alkylation has long been recognized as a vital process in the production of high octane avgas and a valuable tool for upgrading a refinery's motor gasoline pool.

Now several Kellogg design innovations have been incorporated in this process which reduce the initial investment required, as well as the daily operating costs, for the production of a given quality and quantity of alkylate.

The most important improvements have been made in the reactor itself. With the new Kellogg cascade reactor, a highly desirable nine-to-one ratio of isobutane to butylene is maintained *in the reaction zones*—although the overall isobutane *feed* to the reactor is less than four-to-one. While increasing the yield and improving the quality of alkylate, this new design also materially reduces the number of pumps and permits use of smaller vessels than would otherwise be required to attain a high isobutane-butylene ratio.

In addition, the cascade flow of acid and fresh feed in successive stages radically improves the economics of acid consumption. When feeding 98% sulphuric acid to the new Kellogg units, the acid concentration can be maintained at an efficient average of 91.5% in all reaction zones, while the withdrawal concentration is kept at a low 88%.

Add to these advantages the low horsepower requirements of propeller-type agitation and the savings inherent in auto refrigeration cooling . . . and it is evident why many refiners are exploring the possibilities of modern sulphuric acid alkylation.

New Kellogg-Designed Units

UNITS OPERATING

In the Midwest—2500 BPD unit
In the Southwest—1000 BPD unit
On the Atlantic Seaboard—2200 BPD unit

UNITS UNDER CONSTRUCTION

In Texas—1200 BPD unit
In South America—1600 BPD unit

UNITS IN ENGINEERING

On the Atlantic Seaboard—3500 BPD unit
In Texas—1200 BPD unit

For further information, yield and inspection data, etc. write

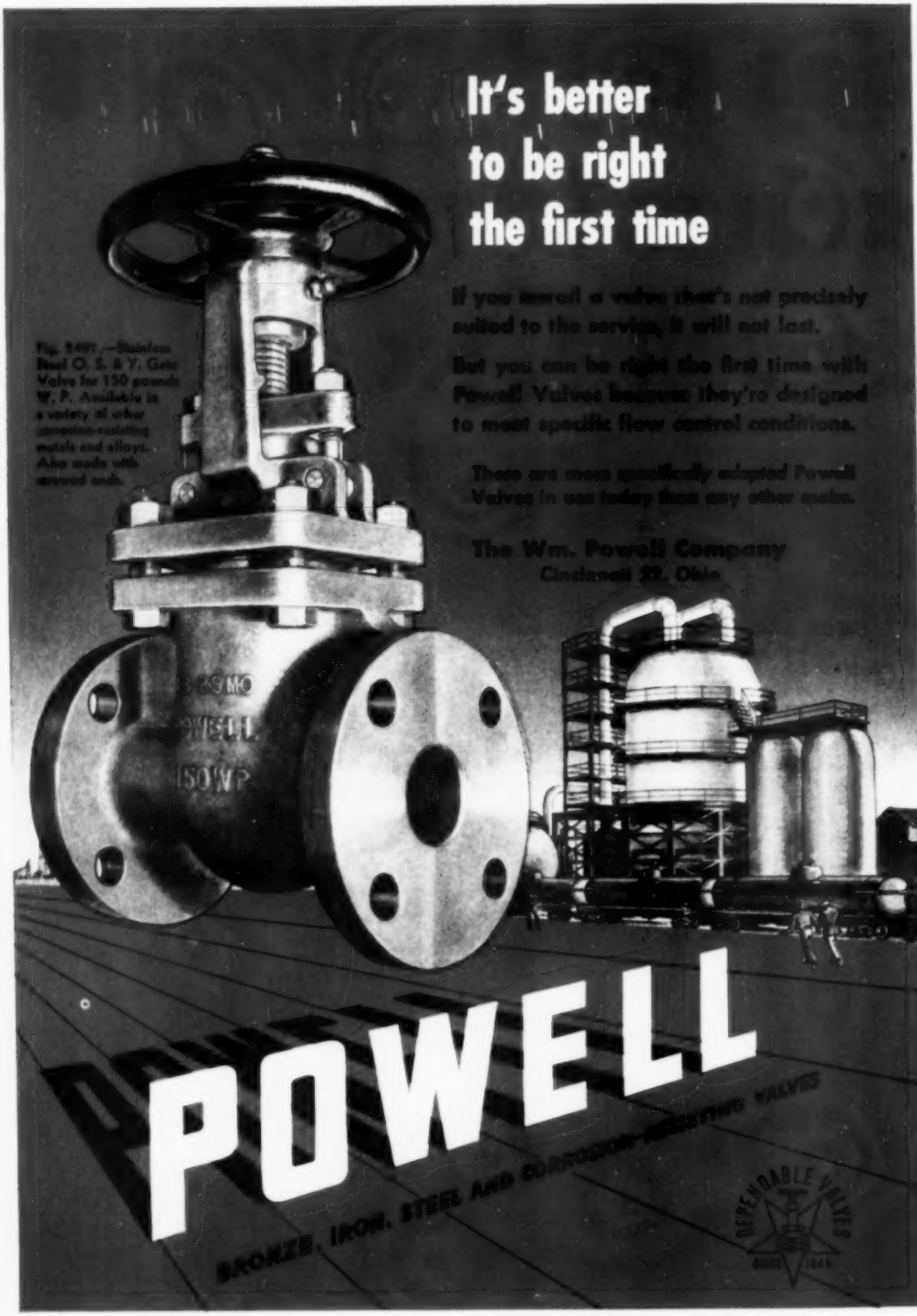
THE M. W. KELLOGG COMPANY

(SUBSIDIARY OF PULLMAN INCORPORATED)

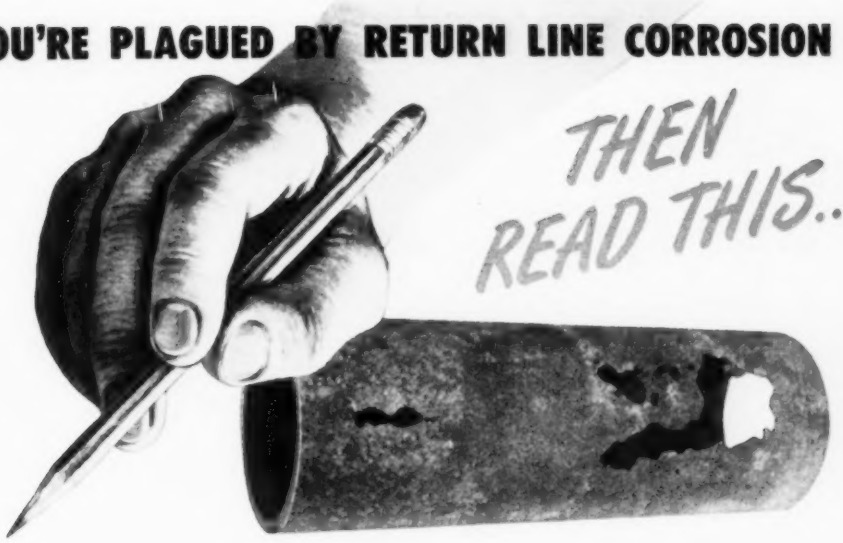
for fifty one years an integral part of petroleum refining progress!

KELLOGG

NEW YORK JERSEY CITY LOS ANGELES TULSA HOUSTON TORONTO LONDON PARIS


It's better
to be right
the first time
If you install a valve that's not precisely suited to the service, it will not last.
But you can be right the first time with Powell Valves because they're designed to meet specific flow control conditions.
There are more specifically adapted Powell Valves in use today than any other make.
The Wm. Powell Company
Cincinnati 22, Ohio
Fig. 5497.—Stainless Steel O. S. & Y. Gate Valve for 150 pounds W. P. Available in a variety of other corrosion-resisting metals and alloys. Also made with screwed ends.
POWELL
BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES
DEPENDABLE VALVES
SINCE 1846

IF YOU'RE PLAGUED BY RETURN LINE CORROSION



As an engineer responsible for efficient, economical plant operation, you know only too well that corrosion of steam and condensate lines can send costs skyrocketing through pipe replacement, interrupted production, and increased labor and maintenance. Perhaps you, like many other engineers, have tried stop-gap methods to check the problem only to find them partially effective or far too costly.

Realizing the importance of this major industrial problem, Betz Laboratories has developed its patented filming amine treatment. Here, at last, is a simple, inexpensive, and practically 100% effective method of eliminating this costly and production-disrupting headache.

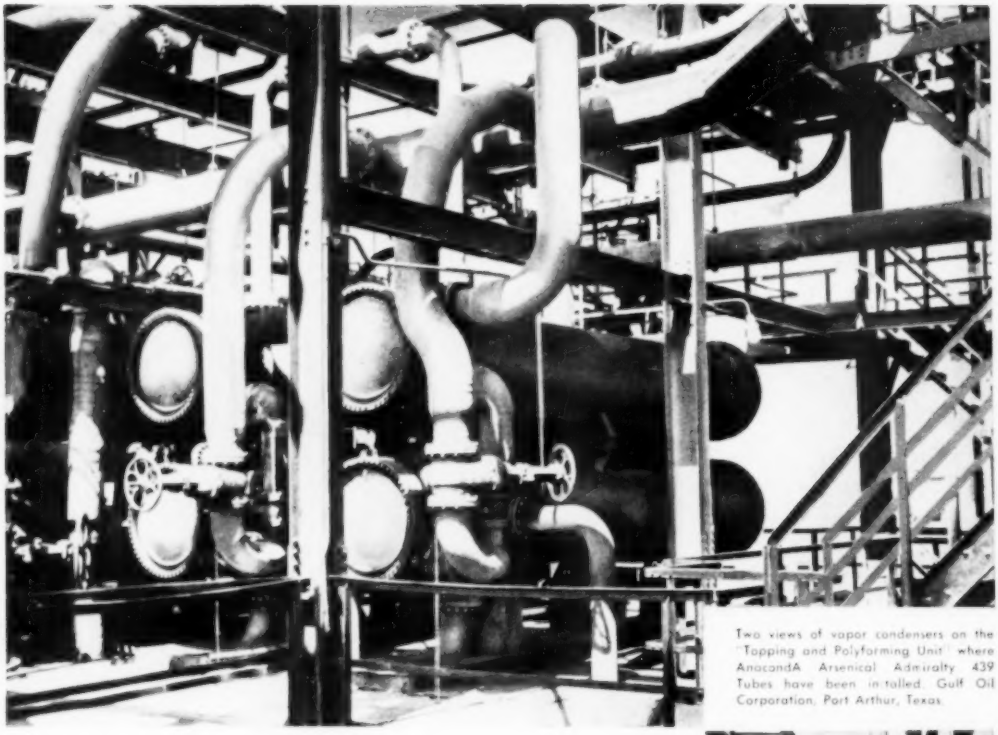
For example, a linoleum company, operating at 150 psi and producing 300,000 pounds of steam per day, employed sodium zeolite softening for a high bicarbonate raw water. The carbon dioxide content of the steam averaged 40 ppm. Continued maintenance was required due to failure of condensate lines from the steam kettles and unit heaters. After the filming amine treatment was applied, maintenance records showed an annual saving of approximately $8,000.00! And, a large part of this saving was obtained by eliminating weekend over-time work on pipe replacements.

Why not take the first step toward ridding your plant of corrosion *now?* Call in a Betz Engineer. Ask him to show you how Betz *Specialized* Water Conditioning Service can help you . . . quickly . . . economically . . . effectively. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: Betz Laboratories Limited, Montreal 1.

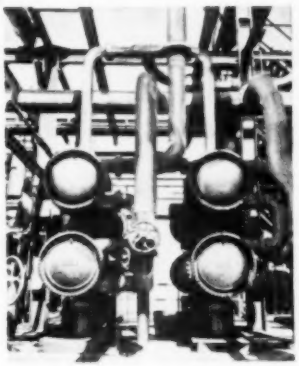
See for yourself how Betz filming amine treatment eliminates return line corrosion and reduces operating costs. Send for Technical Bulletin No. 121.

BETZ

CONSULTANTS ON ALL WATER PROBLEMS



Two views of vapor condensers on the "Topping and Polyforming Unit" where AnacondA Arsenical Admiralty 439 Tubes have been installed. Gulf Oil Corporation, Port Arthur, Texas.



For dependable and economical performance

GULF OIL

SELECTED

ANACONDA ARSENICAL ADMIRALTY 439 TUBES

Like many other important refineries, the huge Gulf Oil Corporation at Port Arthur, Texas, installed ANACONDA Arsenical Admiralty 439 Tubes.

Since conditions among refineries vary widely, selection of the right tube alloy is extremely important. Years of experience in this field have given Anaconda's Technical Department a *wealth of information on various heat exchanger operating conditions—plus effective means of combating them.*

This experience is at your finger tips to assure you the most practical and economical alloy for your particular problem. For information about this or other condenser and heat exchanger tube materials and applications, write to The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

5114

for efficient heat transfer— **ANACONDA®** **HEAT EXCHANGER TUBES**

PETROLEUM CHEMICALS DIVISION
NEWS

April ★ One of a Series of Interest to the Petroleum Industry ★ 1952

Hundreds of Requests for "Pipeline on Wheels" Channeled to Oil Companies

The demand for Du Pont's new movie, "Pipeline on Wheels" has been far heavier than anticipated.

The film, specially designed for oil companies to use in their own public relations programs, shows how gasoline tank trucks are made safe to operate on public highways. It is suitable for showing to civic organizations, state and municipal officials, association meetings and other similar groups.

An unexpectedly large demand for the film sprang up from non-oil organizations such as insurance companies, fire departments and other interested groups and hundreds of these organizations requested the film for their own use. But, because of Du Pont's policy to distribute the film exclusively through the oil companies, these groups have been asked to request a showing from their regular petroleum supplier . . . thus creating public contact opportunities for the oil companies.

New Information on Gasoline Storage Stability

Modern gasolines are modifying our conception of gasoline stability . . . and the ways of measuring it.

Although gum complaints have been few, there has been a growing feeling among refiners that induction period tests are not as satisfactory for predicting storage stability of modern gasolines as they were when applied to earlier fuels.

Some new light was recently thrown on this problem in a paper, "Stability of Present-Day Gasolines," presented by Richard O. Bender at the February meeting of the Western Petroleum Refiners Association in Beaumont, Texas.

This paper, co-authored by N. D. Lawson, A. R. Kernen and R. O. Bender, all associated with the Du Pont Petroleum Chemicals Division, deals with the relationship between accelerated laboratory tests and storage test results, and the effect of additives as measured by these tests.

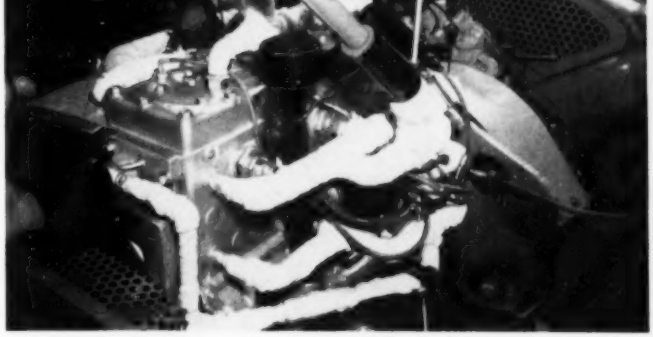
The data presented in the paper are based on laboratory storage tests at 110° F., conducted by the Du Pont Petroleum Laboratory. It indicates that induction periods of modern gasolines do not correlate with stability behavior in this type of storage. The tests also indicate that Metal Deactivator provides much greater storage stability than can be predicted from accelerated tests.

Since much of the information presented in the paper is at variance with accepted concepts of storage stability, it is stimulating discussion in the refining industry. Copies of the paper are available to you through the Du Pont Petroleum Chemicals Division district offices.

Du Pont Petroleum Research Finds New Answers to the Problem of "Knock"

Continuing Du Pont Deposit Studies Offer New Data On How Engine Deposits Affect Octane Requirements

Why does an engine have an increasing tendency to knock during the first few thousand miles of operation? If, as generally believed, deposits are a contributing factor, *how* do they contribute? And do "leaded" gasolines accentuate the increase in knocking tendency?



A PRODUCTION MULTI-CYLINDER AUTO ENGINE was used for studying the thermal insulating effect of engine deposits at the Du Pont Petroleum Laboratory.

The Du Pont Petroleum Laboratory set out to find the answers to these questions and came up with some very interesting results.

The Du Pont research workers found, for example, that knocking tendency of the combustion chamber deposits is independent of the amount of both tetraethyl lead and sulfur present in commercial type fuels and lubricants. Gasolines containing up to 3 ml TEL per gallon were used in the tests.

To accurately determine just how deposits might increase the octane requirement of an engine, the Petroleum Laboratory studied the most likely contributing factors . . .

VOLUME EFFECT

The volume of the deposit itself actually increases the compression ratio by decreasing the combustion chamber volume. Raising the compression ratio naturally boosts the octane requirement of the engine by increasing the temperature and pressure of combustion chamber gases.

This compression ratio increase is proportional to the amount by which the deposit reduces clearance volume.

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

PETROLEUM CHEMICALS DIVISION
NEWS

CONTINUED *Du Pont Research*

So, by measuring the physical volume occupied by deposits, the laboratory was able to calculate the resulting change in compression ratio.

After translating this change into terms of octane requirement, the Laboratory found that 20 to 40% of the knocking harm was due to the volume effect of deposits.

CATALYTIC EFFECT

To study the catalytic effect of deposits on combustion reactions, the Du Pont researchers injected finely divided deposits (and their individual constituents) into the combustion chambers of clean engines. Deposits from both leaded and unleaded fuels were used. The variation in knocking tendency caused by the different deposits was then determined.

Some of the deposits or their constituents increased the octane requirement. And surprisingly, some deposit fuels, mainly those from leaded fuels, produced a definite *reduction* in octane requirement. From this, Du Pont has evidence that an increase in knocking tendency is not necessarily due to the catalytic effect of deposits.

THERMAL INSULATING EFFECT

Since any factor which upsets combustion chamber heat balance may affect octane requirement, the thermal insulating effect of deposits was also studied by the Petroleum Laboratory.

As deposit formation progressed in a test engine, the resulting change in heat transferred to the coolant was measured. For comparison, the effect on octane requirement in a clean engine was also obtained . . . by raising the coolant temperature enough to reduce the transfer from the combustion chamber by an equivalent amount.

By comparing these measurements, it was found that the heat insulating effect of deposits could account for a major portion of the increase in octane requirement.

SERVICE TO PETROLEUM AND AUTOMOTIVE ENGINEERS

Results of these studies in booklet form have been made available through the S.A.E. . . . and the Du Pont Petroleum Chemicals Division. If additional copies are required, ask your nearest Du Pont district office for the booklet "Possible Mechanisms By Which Combustion Chamber Deposits Accumulate and Influence Knock."

CO-AUTHOR OF PAPER ON GASOLINE STABILITY

RICHARD O. BENDER, Assistant Technical Manager of the Du Pont Petroleum Chemicals Division, is co-author of the paper, "Stability of Present Day Gasolines," which is described elsewhere in this issue of the Petroleum Chemicals Division NEWS.

Previous to his present job, he was in charge of the Chemical Division of the Du Pont Petroleum Laboratory. In this capacity, his activities included development and product application work on additives for gasolines, fuel oils, lube oils and greases.

Before joining the Du Pont Company in 1941, Bender was with the Sinclair Refining Company. He was graduated from Swarthmore College with a B.S. in Chemistry.

RICHARD O. BENDER

Du Pont Historical Highlights

E. I. du Pont, founder of the Du Pont Company, early established a tradition of research by conducting experiments in his kitchen. His unending efforts to improve processes and products irritated one stockholder, who thought the Company should stick to what it had. Eventually, Mr. du Pont bought out the shareholder for about five times his original investment.

Since E. I. du Pont's time, the research activities of the Company have been constantly expanded. And, in addition to the general research carried on at the Du Pont Experimental Station, Du Pont scientists are constantly working on the specialized problems of many individual industries. The deposit studies described in this edition of the Petroleum Chemicals Division NEWS are an example of Du Pont's fundamental research on combustion, a field of direct interest to the petroleum and automotive industries.

LITERATURE AVAILABLE

Here is a partial listing of the bulletins, reports, booklets and aids available to you through your Du Pont Petroleum Chemicals Division district office:

Safety for the Small Refinery — A 42-page book on how to set up an effective small refinery safety program. Serial A-2848

Possible Mechanisms By Which Combustion Chamber Deposits Accumulate and Influence Knock. Serial A-2087a

Stability of Present-Day Gasolines — A 12-page paper on the value of storage tests — as compared with induction period—for determining stability of modern gasolines. Serial A-3199

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HELPING TO CUT AMERICA'S *Death Rate*

PLASMA EXPANDER
STREPTOMYCIN
PENICILLIN

AS A RESULT of broad experience in the organic and inorganic chemical field, the Badger Process Division of Stone & Webster Engineering Corporation has made and is making significant contributions in the large scale production of life-saving pharmaceuticals.

Working currently for Commercial Solvents Corporation and General Aniline & Film Corporation, we are helping make it possible for these clients to produce in quantity synthetic expanders for blood plasma. These products do not take the place of blood plasma, but save lives by temporarily sustaining shock victims until they reach a hospital where the blood plasma is available.

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AFFILIATED WITH E. B. BADGER & SONS (GREAT BRITAIN) LTD.

HAMILTON WATCH COMPANY

LABORATORY CHECKS ON MOISTURE IN COMPRESSED AIR

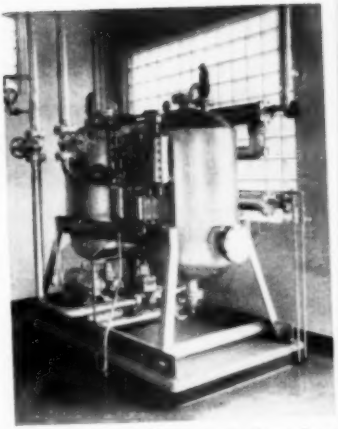
Date	Dep't	Dew Point	Grains/ cu. ft.	Remarks
4/20	Bal. & Flat S.	-50.0° C	.0124	Good
4/20	Works Lab	-50.0° C	.0124	Good
4/23	Bal. & Flat S.	-50.0° C	.0124	Good
4/23	Works		.0124	Good
4/27	Works Lab	+4.0° C	2.800	Poor NOTE: This situation produced when the new compressor was thrown into use without passing the air through the Lectrodryer.
4/29	Bal. & Flat S.	-54.0° C	.0082	Good
4/29	Works Lab	-54.0° C	.0082	Good
5/3	Oil capsule changed			

A lab man's notebook tells why you need Lectrodryers*

Page after page, the report on moisture conditions was "Good". Then *wham!* It jumped from a hundredth grain per foot of air to 2.8 grams. Howls of protest were heard all through this plant —"What's happened to our air?"

A new compressor had been placed in service, bypassing the old Lectrodryer. A quick switch was made and again the report became "Good".

Lab men's notebooks all over the world are telling this same story: Air is kept free of unwanted moisture by Lectrodryers, assuring dependable functioning of air-operated instruments. For help in determining what Lectrodryers will do for you, write Pittsburgh Lectrodryer Corporation, 332 32nd Street Pittsburgh 30, Pennsylvania.



The new Type BY automatic Lectrodryer gives you DRY air at minimum investment

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In Australia: Birlec, Limited, 51 Parramatta Road, Globe, Sydney.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

*REGISTERED TRADEMARK U. S. PAT. OFF.

performance . . .

makes the sale for ROOSEVELT

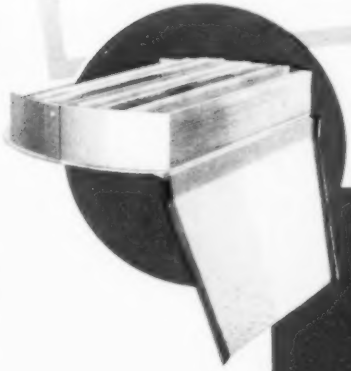
and

KOCH KASKADE TRAYS

produce special solvents tailored to your needs

You'll find the special solvents produced by Roosevelt will help you produce products to meet your high-quality standards. Complete catalytic sulphur removal from Roosevelt's aliphatic naphtas means non-corrosive, chemically stable solvents, free of offensive odors. **Flexible Kaskade-type fractionating towers,** plus constant quality-control analysis means every shipment will meet your specifications. Send us your solvent specifications today!

ROOSEVELT oil and refining corp.



You, too, can satisfy your most critical product requirements...and step up tower capacities and efficiencies with Koch Kaskade trays. *Write for Bulletin No. 629.*

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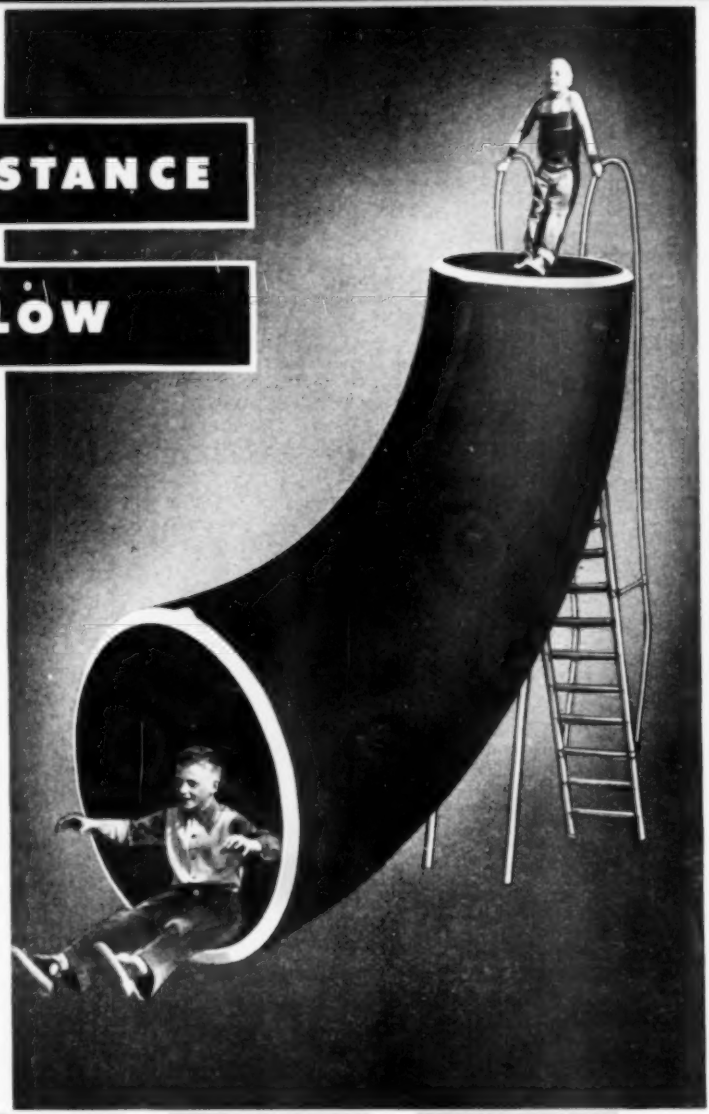
LOW RESISTANCE to FLOW



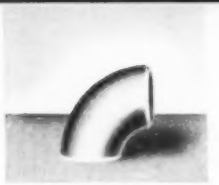
Minimum resistance to flow . . . that is the feature of Midwest Welding Fittings we call to your attention with this photographic fantasy. Other superior qualities that result from our unique manufacturing methods are dimensional accuracy and uniformity . . . true circular cross-section, controlled wall thickness, and accurate radius, included arc and tangents. The consequent benefits are a saving in welding time and a better piping system.

MIDWEST "LONG TANGENT"

Same radius as ASA but tangent equal to 75% of nominal pipe size on each end. Saves pipe, layout and welding time. Costs no more than ASA. Sizes to 24".

ASA STANDARD

Dimensions conform to applicable size range of American Standard for Butt Welding Fittings. ASA Pipe Tolerances, much less than allowable. Sizes to 30".



SHORT RADIUS

Recommended where space limitations do not permit use of "Long Tangent" or ASA Elbows. Sizes to 30".

MIDWEST REDUCING

Takes the place of a straight size elbow and a reducer. Eliminates one weld, reduces pressure drop, easier to insulate. Sizes to 12", reductions to half size.

MIDWEST

PIPING & SUPPLY CO., Inc.

Main Office: 1450 South Second Street, St. Louis 4, Mo.
Plants: St. Louis, Passaic, Los Angeles and Boston
Sales Offices: New York 7—30 Church St. • Chicago 3—79 West Monroe St.
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STOCKING DISTRIBUTORS IN PRINCIPAL CITIES

handles *Boiling HCl* for 2½ years!

This HASTELLOY Alloy Condenser is still on the job in 1-10% Acid Solution

This condenser, made of HASTELLOY alloy B, shows no signs of corrosion after two and one-half years in a vacuum still for the distillation of hydrochloric acid. Since it was installed, the unit has been in operation two to three days a week, eight hours a day, handling a dilute solution of the corrosive acid at temperatures up to the boiling point.

HASTELLOY alloy B is one of the few commercially available materials that can handle boiling hydrochloric acid—one of the most severely corrosive agents known to the chemical industry. Alloy B is available in all standard wrought forms and can be fabricated by most common methods. Two additional HASTELLOY alloys, designated as C and D, are also available for handling other highly corrosive chemicals, such as sulphuric acid and certain strong oxidizing agents, like ferric chloride and wet chlorine.

The 28 in. tubes in this condenser for the distillation of hydrochloric acid are made from ¾-in. diameter, 16-gage welded tubing of HASTELLOY alloy B. The end disks, which are ¾ in. thick by 7 in. in diameter, are also of the nickel-base alloy.

For complete information, write for the 40-page booklet, "HASTELLOY High-Strength, Nickel-Base, Corrosion-Resistant Alloys." It contains data on the properties, available forms, and fabricating techniques for all three grades of HASTELLOY alloy.

HAYNES
TRADE-MARK

"Hastelloy" and "Haynes" are trade-marks of Union Carbide and Carbon Corporation

Haynes Stellite Company
A Division of
Union Carbide and Carbon Corporation
UCC
General Offices and Works, Kokomo, Indiana
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Los Angeles — New York — San Francisco — Tulsa

(To obtain more data on advertised products see page 552)

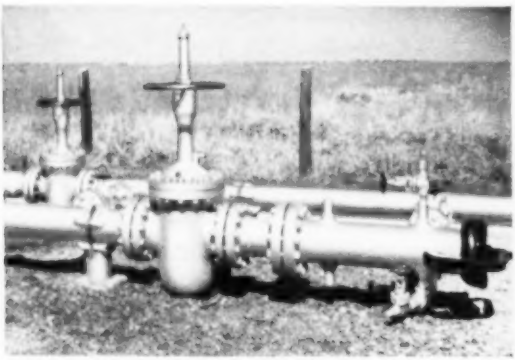
for smoother flow
easier operation
longer service life

...CRANE *CLASS 600*
OIL AND GAS PIPE-LINE VALVES

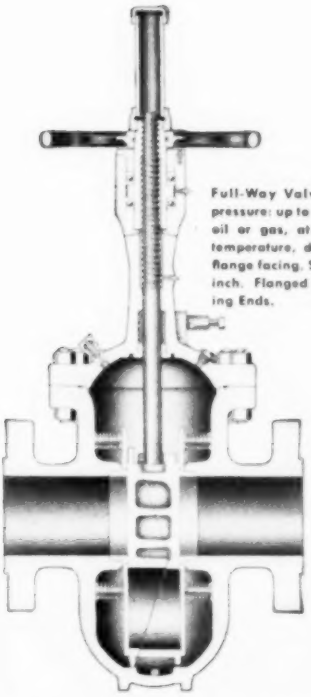
You get many advantages with these conduit-type, double-seating Crane Pipe-Line Gates. For example, smooth, full flow with minimum restriction . . . no turbulence. Circular disc ports—in perfect alignment with seat openings—eliminate pockets. This Crane design feature helps assure tight closure.

Grease packed body and bonnet assure easier valve operation . . . less maintenance. All working parts are lubricated to reduce friction and wear. And since Crane double-seating design seals off seating faces from line flow, seat erosion is eliminated.

For further information, see your Crane Representative or write for Circular AD-1864. No obligation.



Crane cast steel pipe-line gate valves on scraper trap in crude oil lines.



Full-Way Valve. Working pressure: up to 1440 pounds oil or gas, at atmospheric temperature, depending on flange facing. Sizes: 2 to 30-inch. Flanged or Butt-Welding Ends.

COMPLETE GREASE SEALING

Movable spring-loaded plates prevent grease entering line flow while valve is being operated . . . also close "conduit" openings in disc against entrance of grease.

In addition, plates wipe foreign matter and excess grease from disc faces and assist in guiding the disc. Readily accessible fitting in bonnet permits easy addition of grease when needed.

Venturi Type, available with flanged or butt-welding ends.

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VALVES • FITTINGS • PIPE • PLUMBING • HEATING

This is Controlled Volume Pumping

Handling liquefied gas:
pumping 8.0 gph of
compressed liquid
Ethylene at 15,000 psi.
Temperature 0° C.
Suction Pressure 1000 psi.

THIS MILTON ROY CONTROLLED VOLUME PUMP DOES THE JOB . . .

It's a Milton Roy High-Pressure Simplex, operating in the research lab of a major chemical company. Here are a few of the requirements this pump satisfies: Slow speed on the suction stroke to prevent "flashing" of the liquid Ethylene into a gas; special metallic packing which eliminates all leakage, withstands the 15,000 psi compression; refrigeration through the jacketed liquid end to maintain the Ethylene in a liquid state; explosion proof operation—liquid Ethylene mixed with prescribed percentage concentrations of air is explosive. Field reports indicate complete operating efficiency of this unit.

The successful pumping of a hydrocarbon of the peculiar and difficult nature of liquid Ethylene indicates the versatility of Milton Roy Controlled Volume Pumps. The fact that liquid Ethylene is an important building block for many organic compounds—used in anti-freezes, plastics, insecticides, resins etc.—makes high-pressure pumping of this liquid in controlled volume an industrial necessity.

And for those diversified liquids usually considered as gases at normal temperatures and pressures—carbon dioxide, Butane, Vinyl Chloride, Propane, Propylene, to mention just a few, Milton Roy Controlled Volume Pumps have pin-point application. They give flawless service.

Call the Milton Roy representative listed in your classified telephone directory for additional information on Milton Roy Controlled Volume Pumps for *your* specific process problem. Or write us direct.

WITH THE EXCLUSIVE STEP-VALVE DESIGN

MILTON Roy COMPANY

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MANUFACTURERS OF CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS

NEW
FLUID CAT CRACKER....

for THE BAY PETROLEUM CORPORATION
Chalmette Refinery . . .

BUILT BY PROCON

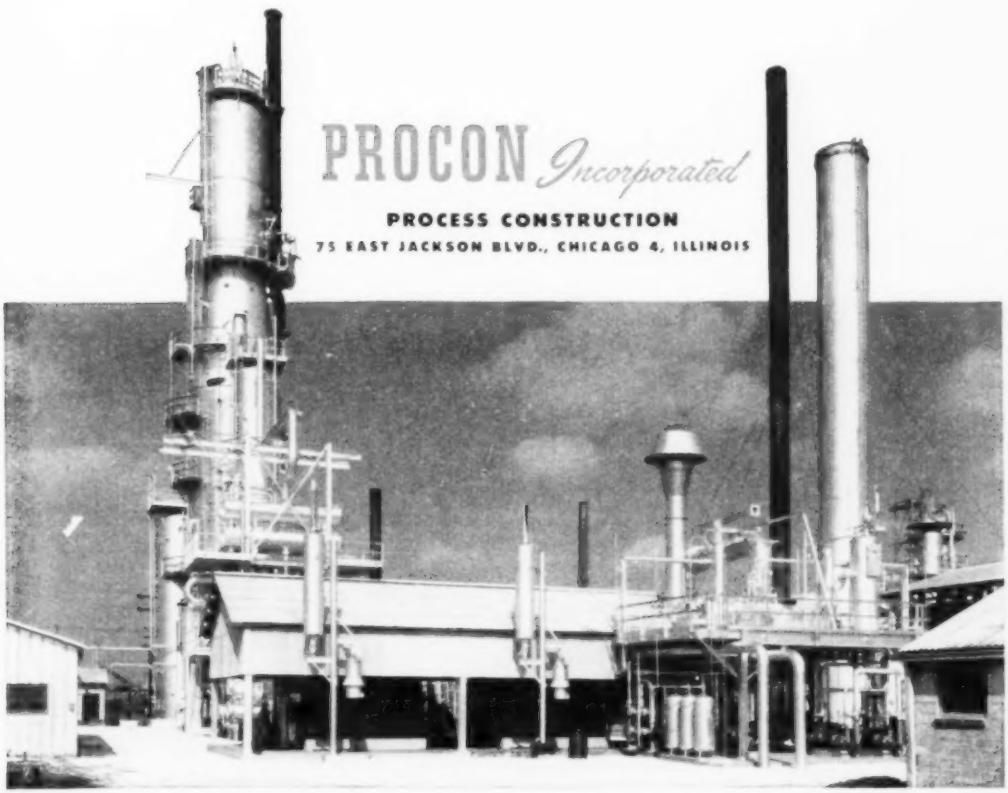
Completed within nine months, this 5600 b/d UOP Fluid Catalytic Cracking Unit was built by Procon for The Bay Petroleum Corporation, Chalmette (La.) refinery with less than 30 days' interruption in plant operations. Shut-down time was minimized by fast work in converting existing equipment to use with the new cracker.

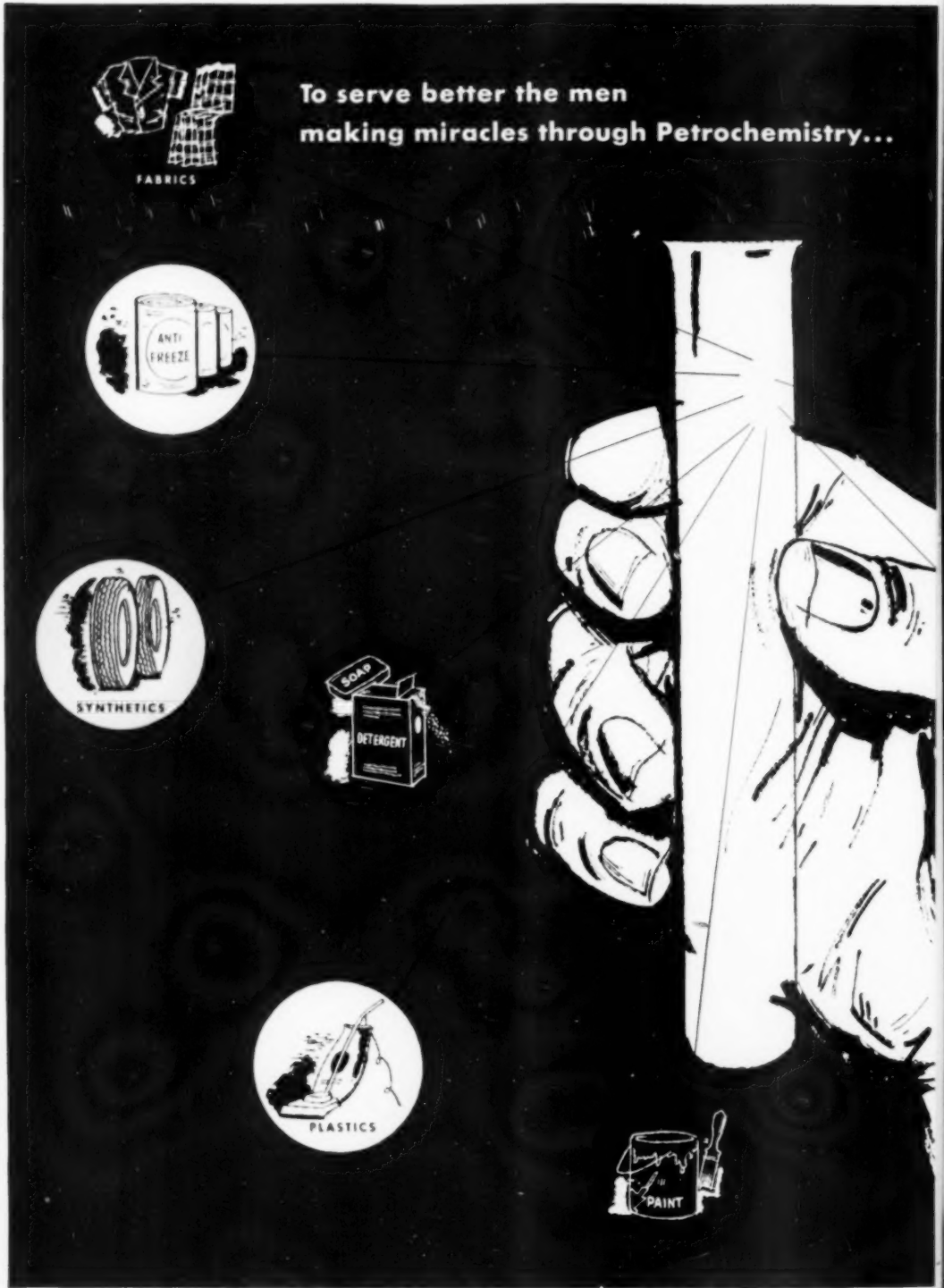
While this new unit was still under construction, Bay Petroleum placed an order with Procon for a second UOP fluid cat cracker to be built at their Denver refinery. Such confidence is convincing evidence of Procon's ability and facilities to handle any refinery or petro-chemical plant construction job.

PROCON *Incorporated*

PROCESS CONSTRUCTION

75 EAST JACKSON BLVD., CHICAGO 4, ILLINOIS




To serve better the men
making miracles through Petrochemistry...
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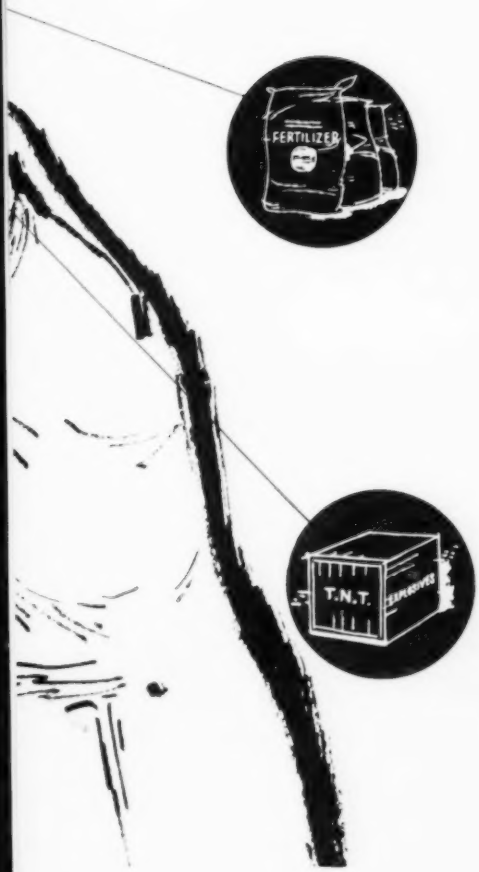
Petroleum Processing introduces a new monthly section

Petrochemical Processing

to report authentically and completely the amazing progress of America's fastest-growing industry



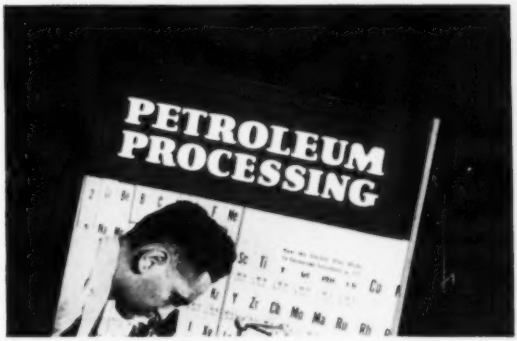
From test tubes of the petrochemical industry have come wonderful new materials, made from petroleum and natural gas, for an ever-increasing number of products in both peacetime and defense classifications.

Plant investment for petrochemical development doubled in the ten years up to 1949. It has multiplied ten times since World War II. Personnel has spiraled, with thousands of technicians in various allied fields turning to specialization in this dramatic new area of chemistry.

And now, in its new *Petrochemical Processing* section, *Petroleum Processing* offers the most complete editorial coverage ever devoted by any oil or chemical publication to this fast-growing industry.

Oil company development of large-scale, continuous-processing operations led the oil industry into the field of petrochemicals. It was a natural evolution. Just as naturally, *Petroleum Processing* now expands its coverage of this new field. Through the years, it has reported all major applications of continuous-process technique to petrochemistry. Its new, specialized *Petrochemical Processing* section is another indication of alert, progressive editorial approach.

Through timely and thorough reporting . . . through devotion of more editorial space than ever before . . . through expanding controlled circulation . . . *Petroleum Processing* keeps pace with the men who are making miracles through petrochemistry.



(To obtain more data on advertised products see page 552)

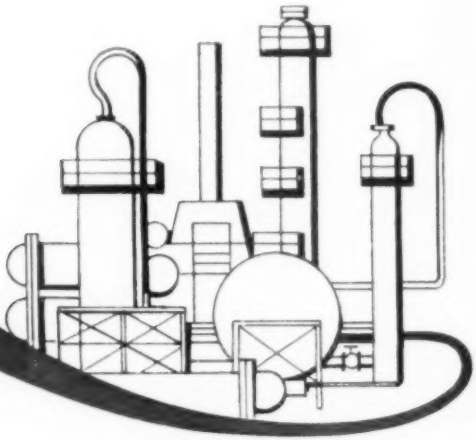
FOR BETTER PROTECTION AGAINST CORROSION IN THE REFINERY

Kontol is a non-volatile, heat-stable, semi-polar organic corrosion preventive. It is soluble in most distillates and crude oils and is available in two forms, water-insoluble and water-emulsifiable. It protects against corrosive attack by adsorbing at metal surfaces in the form of a thin, impervious film, thereby preventing contact between corrosive elements and metals. Excellent protection has been attained when temperatures were as high as 300 F. Kontol is stable at temperatures up to 550 F plus.

Kontol has been effective in preventing corrosion in piping systems, pumps, fractionating towers, stripping columns, cooling water systems, heat exchangers and separators. Injected into a refinery system, Kontol continues to afford corrosion protection to all the metal surfaces it contacts, consequently, its protection action is extended downstream from the initial injection point.

The use of Kontol does not affect the properties of refined products, such as end point, gum formation, anti-knock rating, color, ash, etc.

If corrosion is causing lost on-stream time in your refinery, request a Tretolite Company corrosion rate survey. Such a corrosion survey is yours for the asking and entails no obligation. It may enable your refinery to substantially reduce corrosion losses. Why not request it today?



TRETOLITE COMPANY
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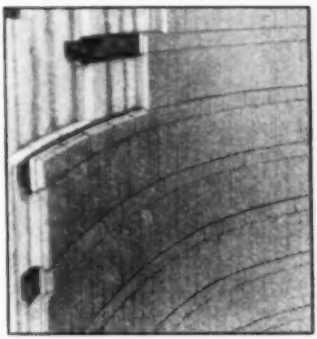
CHEMICALS FOR THE PETROLEUM INDUSTRY

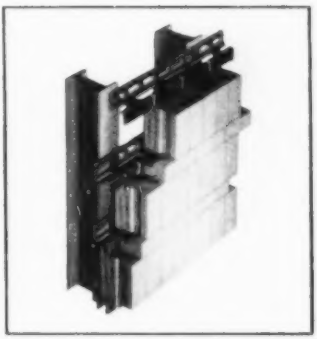
CORROSION INHIBITING • DESALTING
DEHYDRATING • WATER DE-OILING
SCALE PREVENTING

AR 52-4

Thin refractory walls—backed up with insulation—cut the costs of oil still installations. When tile are shaded by tubes, 3" walls are used; 4½" walls are specified for exposed walls of moderate temperatures.

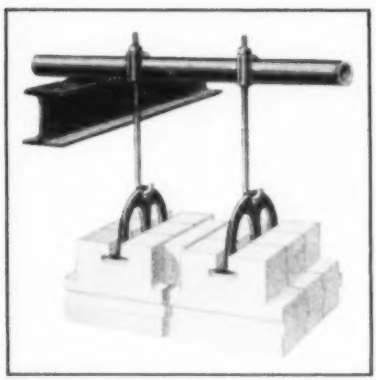


Here is a Bigelow-Liptak wall curved to fit a 25-foot diameter vessel lining. It is backed up with insulation and is hung from modified circular brackets. B-L walls and arches can follow any furnace contour.



When the going is really tough, B-L engineers select rugged 7" walls. Unit-suspended B-L walls eliminate cumulative loading and expansion. Repairs are to damaged tile, adjacent areas are untouched.

Heavy-duty B-L linings reduce oil still repairs



This pendulum-type Bigelow-Liptak arch permits the tile to swing freely in four directions. There is no cumulative loading or expansion thrusts against side walls. Arches are available in any thicknesses, follow any contour. Radial noses are similar.

Repairs are made quicker and at a much lower cost when oil stills are lined with Bigelow-Liptak walls and arches. Because heavy-duty refractories and insulation are used throughout, B-L linings stand up under the toughest of operating conditions.

Refinery boilers are enclosed with special applications of the same type of construction outlined above. When tubes are closely spaced, Bigelow-Liptak's new tube-supported wall is used. Both oil stills and boilers are covered with B-L's casing—TEXAD*. This new covering method is weatherproof, looks better, and replaces steel plate.

Catalogs describing refinery furnaces, the tube-supported wall, and TEXAD* are available upon request. Write today.

*Trademark

BIGELOW-LIPTAK

Unit-Suspended Walls & Arches

BIGELOW LIPTAK Corporation

CURTIS BUILDING • DETROIT 2, MICHIGAN

IN CANADA

BIGELOW-LIPTAK OF CANADA, LTD., TORONTO, ONTARIO

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(To obtain more data on advertised products see page 552)

it's a matter of record...

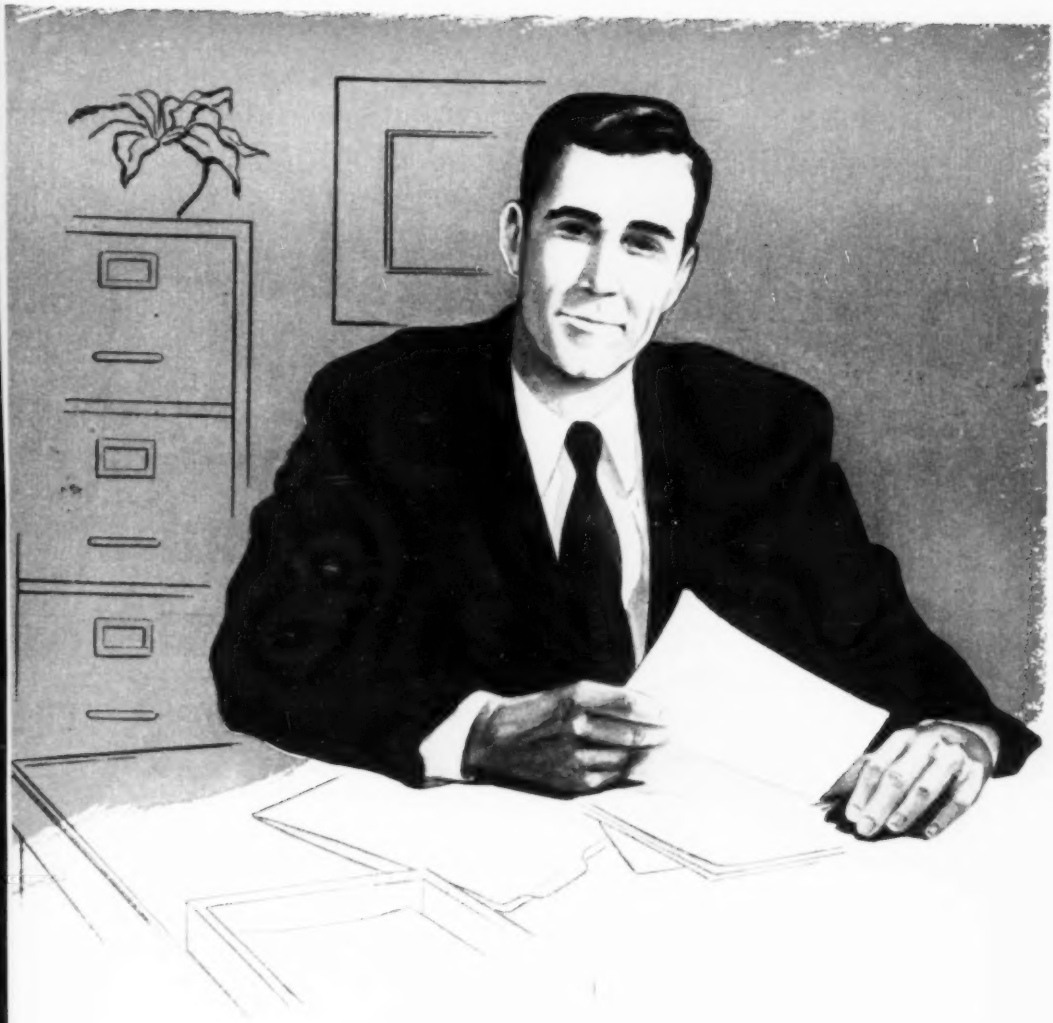
PLATFORMING

is the proved
solution to the refiner's
reforming problem

"Yes . . . *it's a matter of record.* Platforming has proved itself. You're not experimenting when you choose Platforming—you're dealing with a reforming process that is backed by almost three years of actual *commercial* operation. And of course you get the benefit of the experience of other refiners who have chosen Platforming."

It's a matter of record that Platforming has solved many problems presented in various field conditions and it has met the complexities of a wide range of charge stocks. It's rugged and adaptable.

PETROLEUM PROCESSING, April, 1952



It's a matter of record that more than one refiner has met the demand for premium gasoline by merely increasing the severity of processing conditions and producing a higher octane Platformate . . . and that sales departments thank Platformed gasoline for wider markets and bigger gallonage.

Yes, Platforming is the proved reforming process . . . proved and approved by the petroleum industry. *It's a matter of record.*

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UOP

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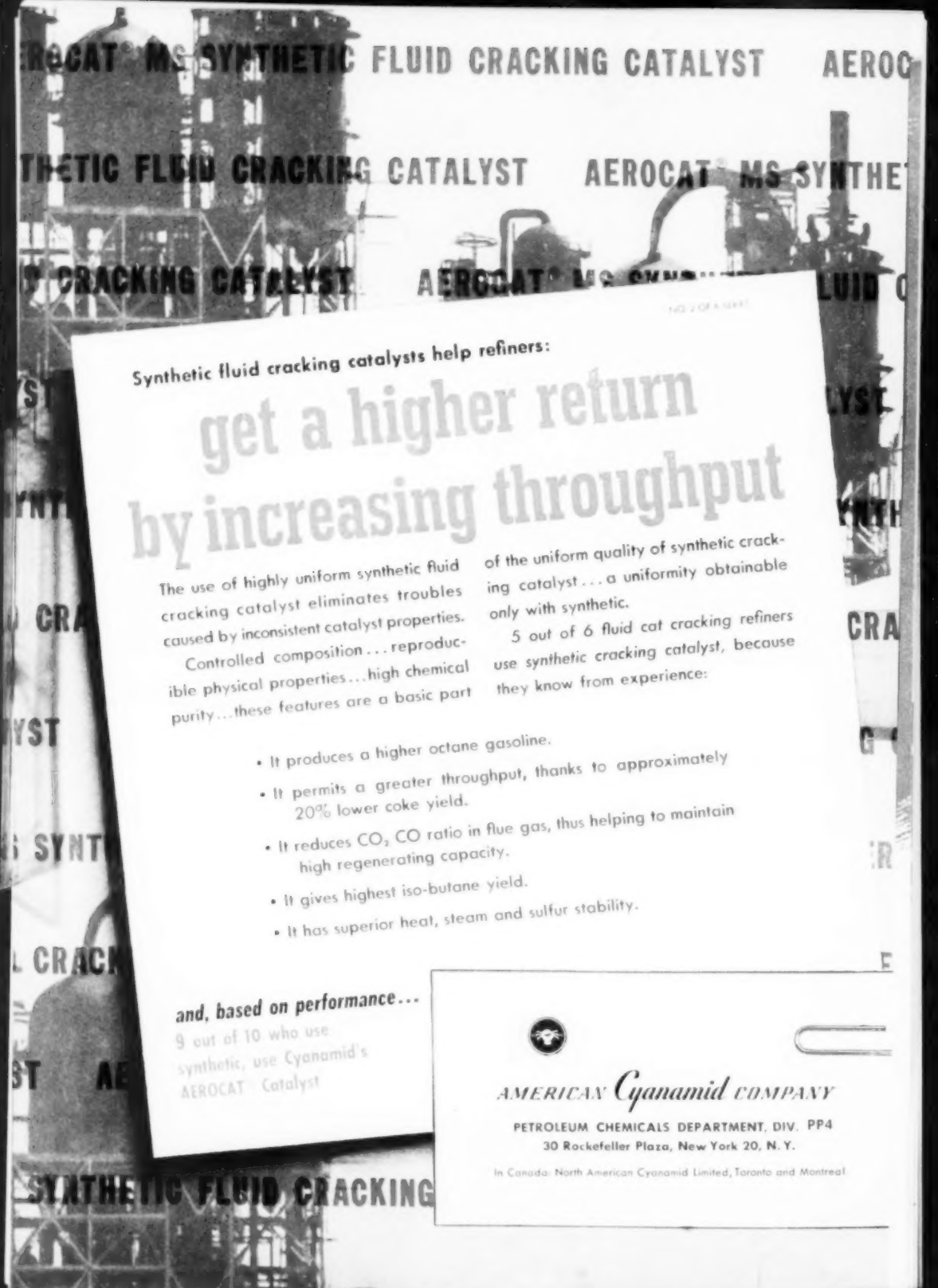
LABORATORIES: RIVERSIDE, ILLINOIS

Universal Service Protects Your Refinery

(To obtain more data on advertised products see page 552)


AEROCAT MS SYNTHETIC FLUID CRACKING CATALYST
AEROCAT MS SYNTHETIC FLUID CRACKING CATALYST
SYNTHETIC FLUID CRACKING

Synthetic fluid cracking catalysts help refiners:

get a higher return by increasing throughput

The use of highly uniform synthetic fluid cracking catalyst eliminates troubles caused by inconsistent catalyst properties.

Controlled composition . . . reproducible physical properties . . . high chemical purity . . . these features are a basic part of the uniform quality of synthetic cracking catalyst . . . a uniformity obtainable only with synthetic.

5 out of 6 fluid cat cracking refiners use synthetic cracking catalyst, because they know from experience:

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- It permits a greater throughput, thanks to approximately 20% lower coke yield.
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- It gives highest iso-butane yield.
- It has superior heat, steam and sulfur stability.

and, based on performance...

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from the

NATURAL GASOLINE SUPPLY MEN'S ASSOCIATION

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THIRTY-FIRST ANNUAL CONVENTION

of the

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April 30, May 1-2, 1952, Rice Hotel, Houston, Texas

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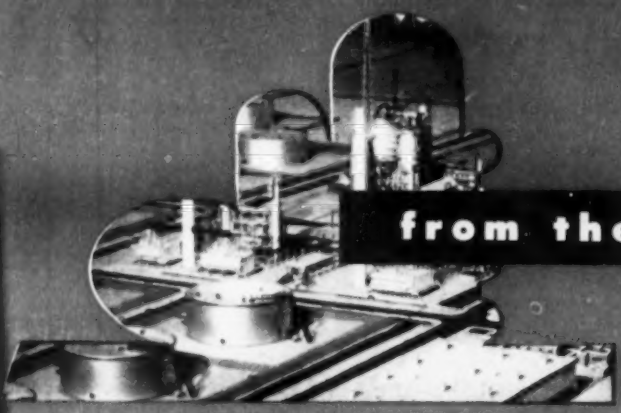
new products



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These products are now being made in petroleum refineries.

Foster Wheeler's integrated engineering and construction organization has served both the petroleum and chemical industries for over 30 years in the design and construction of process units and complete refineries and chemical plants.

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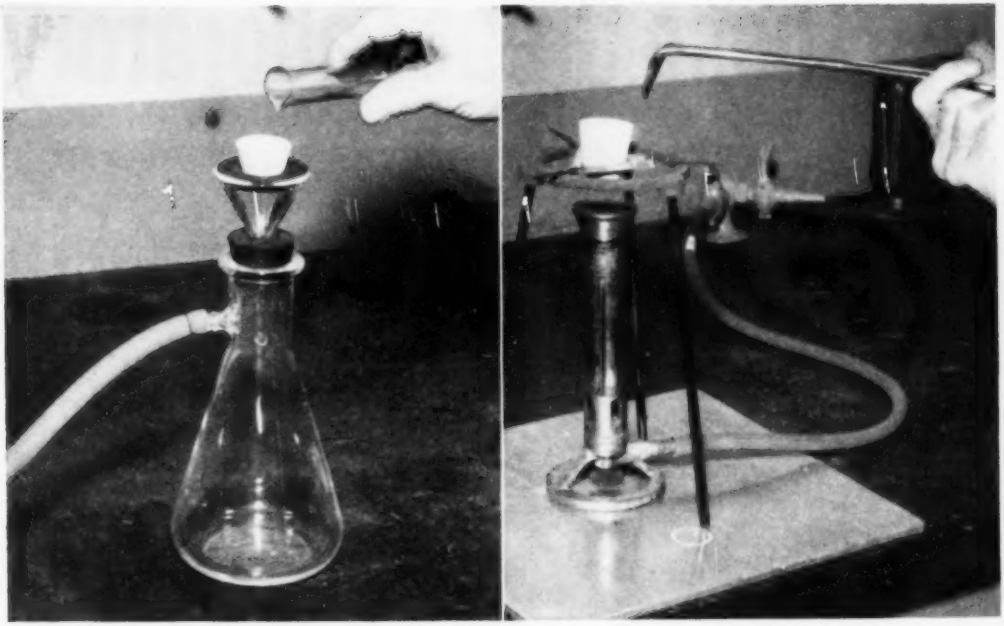

SERVING A DOUBLE PURPOSE. Filter crucibles of Norton ALUNDUM are unique in that precipitates may be both collected and ignited in them, without transfer to another receptacle. Photographs show how the same device is used for each of these two functions.

You save time and work with Alundum* laboratory ware

Made of purest fused alumina, expertly bonded and fired, Norton ALUNDUM laboratory ware offers technicians an exceptionally useful combination of properties. For example:

CHEMICAL STABILITY—ALUNDUM ware is unattacked by any organic solvent, being affected only by hydrofluoric acid, concentrated phosphoric acid and strong, hot caustic solutions.

HIGH MELTING POINT—Only slightly below that of its fused alumina base—2050°C.

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NORTON ALUNDUM LABORATORY WARE is made in many shapes for many uses. The group shown includes crucibles, ignition capsules, flame collars, filter cones, dishes, discs and extraction thimbles.

GET BULLETIN 793

For complete data, including prices, contact your laboratory supply house, or write direct for Bulletin 793. Norton Company, 260 New Bond Street, Worcester 6, Mass.

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Making better products to make other products better

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LABORATORY WARE

CARRIED IN STOCK BY MOST LABORATORY SUPPLY HOUSES

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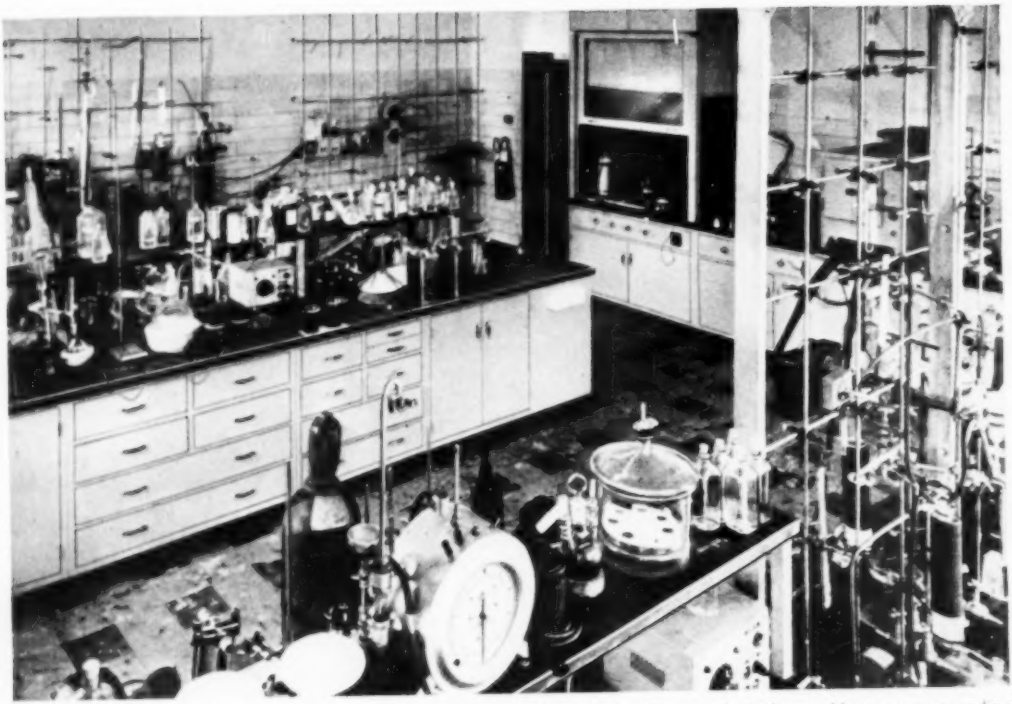
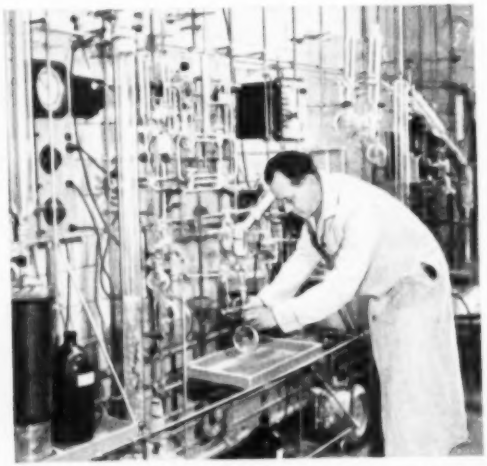
These Great Laboratory



PETROCHEMICALS offer independent inventors great opportunity for exploration and reward. Such synthetics as Nylon, Vinylite, Neolite are already indispensable to our expanding economy—and new ideas in this area are at a premium today.



UNDER THE SINCLAIR PLAN, chemistry laboratories like these are open for the first time to independent inventors.

ELECTRON MICROSCOPE, capable of magnifying 100,000 times, is typical of the expensive equipment now available.

Facilities Are Open to You

Many inventive people have responded to the Sinclair Plan's offer of laboratory facilities — to others who wish to do so, a suggestion: There is promise and profit in oil-based synthetics.

EIGHT months ago, Sinclair turned over a part of its great laboratories at Harvey, Illinois, to independent inventors who had promising ideas in the field of petroleum products but who did not have the facilities needed to develop or prove out their ideas.

To date nearly 5,000 people have submitted ideas to the laboratories, and the Plan is recognized as a valuable service to independent inventors. As a result we have made the Sinclair Plan part and parcel of the long-range operation of our company.

There may be inventive people interested in this Plan but wondering what sort of ideas or what areas would be profitable to explore. To those people we suggest the field of petrochemicals. Such things as plastics, synthetics, substitutes and new materials as yet undeveloped — made from petroleum — offer great opportunities for invention and reward.

If you have an idea of this sort — or in the general area of petroleum products or applications — you are invited to submit it to the Sinclair Research Laboratories. In your own interest, each idea must first be protected by a patent application or a patent.

The inventor's idea remains his own property

If the laboratories select your idea, they will make a very simple arrangement with you: In return for the laboratories' work, Sinclair will receive the privilege of using the idea for its own companies, free from royalties.

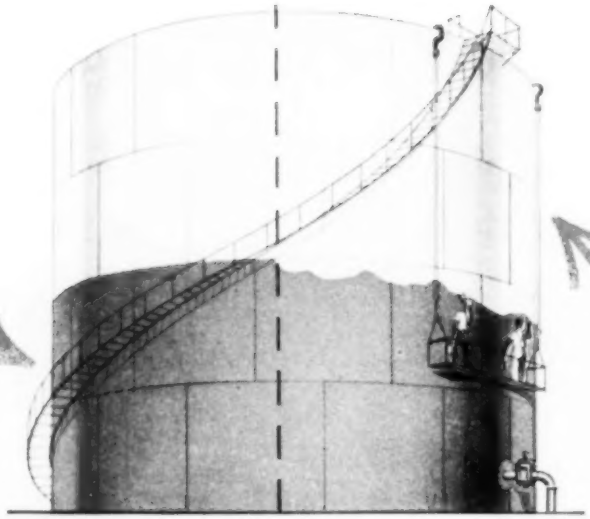
This agreement in no way hinders the inventor from selling his idea to any of the hundreds of other oil companies for whatever he can get. Sinclair has no control over the inventor's sale of his idea to others, and has no participation in any of the inventor's profits.

HOW TO PARTICIPATE: Instructions are contained in an Inventor's Booklet available on request. Write to: W. M. Flowers, Executive Vice-President, Sinclair Research Laboratories, Inc., 600 Fifth Avenue, New York 20, N. Y.

IMPORTANT: *Please do not send in any ideas until you have sent for and received the instructions.*

SINCLAIR RESEARCH LABORATORIES—nine buildings containing the most modern testing equipment known—have contributed many of today's most important developments in petroleum. Under the Sinclair Plan, the available capacity of these great laboratories is being turned over to work on the promising ideas of independent inventors everywhere.

SINCLAIR—for Progress



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- **SELF-CLEANING**—stays brilliant white
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Start the job *right*—with the heavy-duty, *multiple-pigment* primer proved in more than 25 years of industry-wide service—Sherwin-Williams KROMIK Primer. KROMIK includes not only the best protective properties of red lead, but also those of three other protective pigments as well.

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COVER THE EARTH

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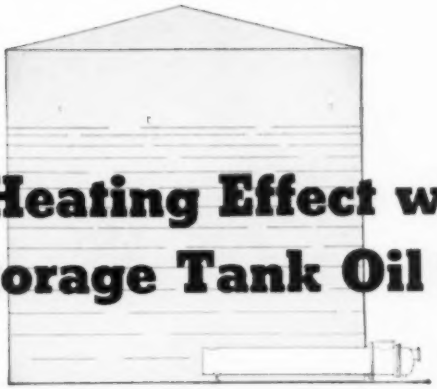
PETROLEUM FINISHES

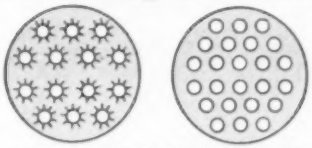


Greater Heating Effect with the G·FIN Storage Tank Oil Heater

because....

1.

Greater Access of Oil to Heating Elements



At left is a tube sheet of a G-R finned-tube heat exchanger. At right is a tube sheet of a typical bare-tube heat exchanger. Note the greater access space between tubes in the G-R exchanger.

2.

Greater Heating Surface of G·FIN Elements

Even in sub-zero temperatures, the G-R G-Fin Storage Tank Oil Heater assures a steady flow of oil soon after the steam is turned on. That's because (1) the wider tube spacing allows the viscous oil greater access to the tubes than in a conventional heater and (2) the G-Fin elements provide six to eight times the heating surface of bare tubes.

Greater heating effectiveness is only one of the important reasons why users prefer the G-R G-Fin Storage Tank Oil Heater. These units use less steam because they heat oil only locally at point of withdrawal. The straight-through flow of oil results in minimum pressure drop. There's no stratification or vapor binding because the oil outlet is located at the top of the shell. And there are fewer tubes and tube joints to maintain.

These and other advantages of the G-Fin Storage Tank Oil Heater have been fully proved in thousands of installations. Write for Bulletin describing these units in detail.

TYPICAL APPLICATIONS OF G-R G-FIN STORAGE TANK OIL HEATER

STORAGE TANKS—containing heavy oils, tar or asphalt at refineries, tank farms, etc.

SERVICE TANKS—serving oil-burning boilers at central power stations, industrial plants.

LOADING WHARVES—to speed up transfer of oil to and from tanks, lighters, barges or cars.

CHEMICAL PLANTS—wherever viscous oil or other liquids must be transferred in bulk.

GAS PLANTS—where by-product tar or heavy oils must be heated.

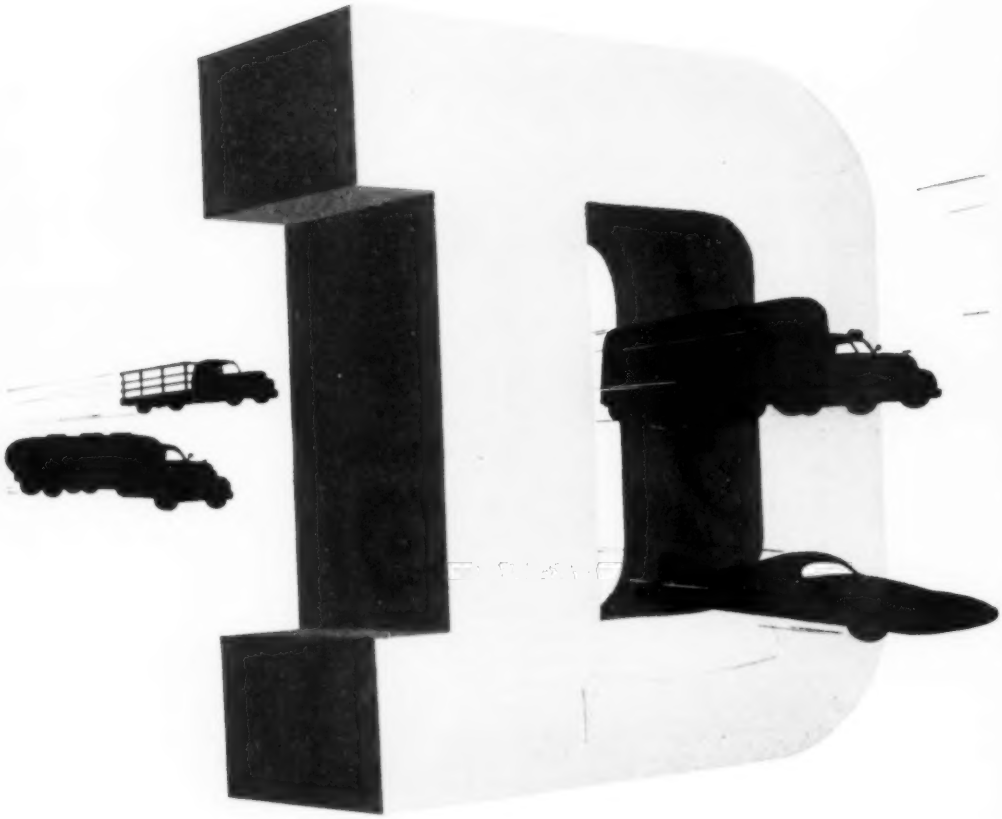
MISCELLANEOUS—for heating cottonseed oil, molasses, road oil and other viscous liquids.

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

GR-223

GRISCOM-RUSSELL

PIONEERS IN HEAT TRANSFER APPARATUS



DAVISON DEPENDABLE CATALYSTS BUILD BETTER MOTOR FUEL

The operating efficiency of synthetic fluid-type cracking catalysts is important. This operating efficiency can be assured by uniformity of physical characteristics and chemical purity. Davison's production of microspheroidal (M-S*) is tops in uniformity . . . providing all users with a highly efficient synthetic fluid-type cracking catalyst. Your requirements can also be supplied in ground (DA-1*) form. Write for further descriptive information. Experienced Davison Field Service Engineers backed up with complete laboratory testing facilities are part of Davison's service.

*T.M.T.D.C.C.

Progress Through Chemistry

THE DAVISON CHEMICAL CORPORATION

Baltimore 3, Maryland

PRODUCERS OF CATALYSTS, INORGANIC ACIDS, SUPERPHOSPHATES, PHOSPHATE ROCK, SILICA GELS, SILICOFLUORIDES AND FERTILIZERS

Sell Butane at Gasoline Price

THE VAPOR PRESSURE OF CATALYTICALLY CRACKED GASOLINE CAN BE AN IMPORTANT REVENUE FACTOR. TABULATED BELOW ARE TYPICAL FIGURES SHOWING THAT AT NORMAL CATALYTIC CRACKING YIELDS, FILTROL'S NATURAL CATALYST (GRADE 58) WILL PERMIT THE INCLUSION OF TWICE AS MUCH BUTANE AS OTHER CATALYSTS IN GENERAL USE. THIS REPRESENTS ABOUT $700 PER DAY ADVANTAGE FOR FILTROL CATALYST, EXCLUSIVE OF OTHER ADVANTAGES.

	FILTROL* CATALYST FLUID 58	OTHER CATALYSTS
FEED B.D.	10,000	10,000
GASOLINE C₅ 420°F B.D.	4,800	4,400
RVP	5.0	6.8
OCTANE NO. F-1 CLEAR	90.0	91.6
OCTANE NO. F-1 + 3cc TEL	96.0	96.8
R.V.P. OF PRESSURED GASOLINE	10.0	10.0
B.D nC₄ REQUIRED FOR PRESSURING	500	250
TOTAL B.D 10# GASOLINE	5,300	4,650
DOLLAR ADVANTAGE	$700 D. BUTANE SAVINGS ALONE	

(Basis 7c gal. differential in sale price between n-butane and gasoline)

OTHER REASONS FOR USING FILTROL CATALYSTS:

1. Higher octane barrels
2. High butylene yield
3. Low cost
4. Sulphur resistant catalysts
5. Faster regeneration rate
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9. Low attrition rate

FILTROL CORPORATION

OFFICES: 521 WEST SEVENTH ST., LOS ANGELES 17, CALIFORNIA
PLANTS: VERNON, CALIF.; SALT LAKE CITY, UTAH; JACKSON, MISS.

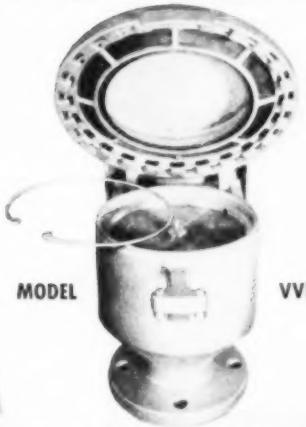
Filtrol* CATALYSTS AND ADSORBENTS

Positive Pressure Relief! Efficient Fire Protection! Lower Maintenance Costs!

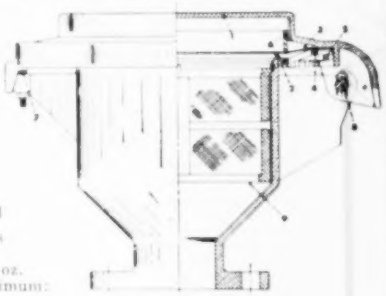
with the BS&B

COMBINATION

VENT VALVE FLAME ARRESTER



The BS&B Model VVFA is a compact valve assembly that gives you many advantages. Its patented cantilever type arrangement of a synthetic rubber gasket eliminates metal-to-metal seating and provides a tight seal that increases in tightness until the pressure rises to the dead weight setting of the bonnet, thus assuring continued positive reseating. This gives you high vapor conservation and greater economy in operation. The arrester bank is housed in the valve body. Snuffing action is automatic. The arrester bank can be removed for cleaning or replacement without taking the valve out of service since the valve bonnet does not have to be removed. The cantilever type gasket can also be easily removed from the bonnet.



MATERIAL SPECIFICATIONS

Bonnet: cast aluminum
Body: cast iron
Retaining ring: cast aluminum
Vacuum ring: steel
Plug: synthetic rubber
Arrester bank: rolled corrugated aluminum
Flange: 125# A.S.A. standard
Sizes: 2, 3, 4 and 6-inch sizes available
Vacuum Setting: 0.5 oz. to 2 oz.
Pressure Setting: 0.5 oz. minimum; 16 oz. maximum all sizes

Note: Available in other materials of construction on special order.

OPERATION DATA — MODEL VVFA Valve seat (2) is sealed by rubber gasket (3), vacuum ring (6) and internal pressure. As internal pressure approaches valve setting, patented cantilever type plug is disengaged from valve seat and bonnet (1) rises. Under vacuum conditions, atmospheric pressure is imposed to underneath side of plug. This permits "inbreathing" when pressure approaches 0.5 oz. setting of vacuum ring. A web-type support (4) holds plug in place. The valve also includes retaining ring spring (5), bumper spring (7), hinge (8) and arrester bank (9).

BS&B Vent Valve—Model VVH

Contains all features of Model VVFA with exception of arrester bank. Can be used as a secondary relief valve with higher setting. Also as primary relief valve on non-flammable materials. The larger sizes of Model VVH can be used as a manway, thus saving an additional tank opening. Material specifications are the same as Model VVFA.

Ask Your Tank Manufacturer for BS&B Vent Valves on Your Equipment! To get greater economy of operation, ask to have the BS&B Combination Vent Valve-Flame Arrester installed on your equipment. Our engineers will work with your fabricators to meet your particular requirements.

ENGINEERING STUDY OF YOUR REQUIREMENTS
You are not obligated in any way when a BS&B engineer makes an analysis of your properties. Perhaps his recommendations will show you how to get more efficient, economical, safe operation.

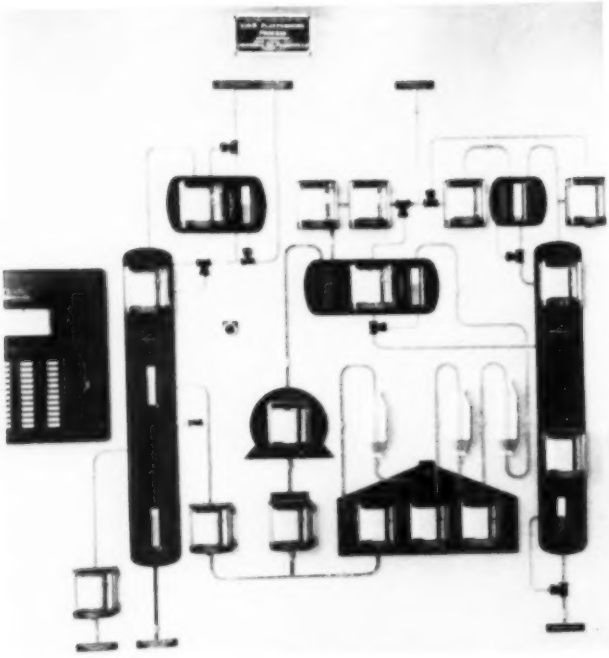
NOW AVAILABLE Bulletin No. 601, which gives complete information on this equipment. **Write for your copy today.**

SAFETY BS&B HEADS

BLACK, SIVALLS & BRYSON, INC.

DEPT. 2-047500 E. 12TH ST. KANSAS CITY 3, MISSOURI

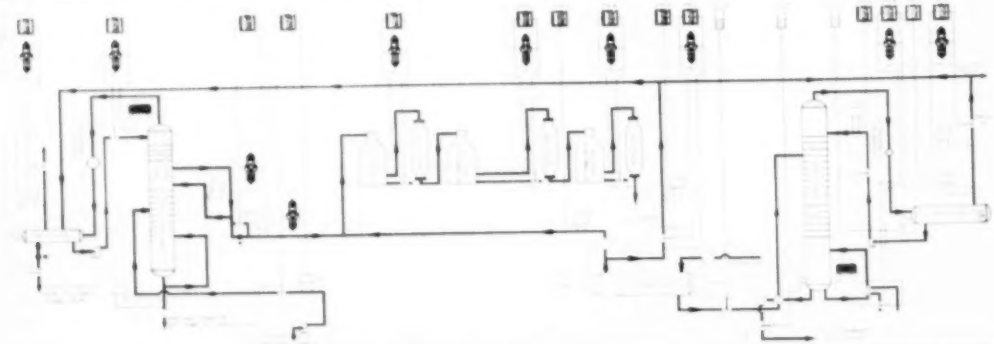
Why did Mid-West PLATFORMING



The Graphic Panel at left, with 16 Trasser Recorders, also was designed by Universal Oil Products Company, to show all critical variables and control points of the Platforming process at a glance. Operator can check all parts of the process, make any desired changes, right on the board. Trasser Recorders shown connect to Tru-Act Controllers on rear of the board, connected in turn to field mounted Taylor Transmitters.

• • •

The drawing below shows the schematic flow diagram and instrumentation of the Platforming process, indicating the wide use of Taylor transmitters, controllers and recorders for maximum efficiency.



(To obtain more data on advertised products see page 552)

Refineries put under TAYLOR TRANSET* CONTROL?

Mid-West Refineries, Inc. at Alma, Michigan, just looked at the performance of Taylor Controls they've used before. Then it was only natural to choose Taylor's exceptionally accurate new three-part TRANSET Control System for their new Platforming process, designed by Universal Oil Products Company and built by Procon, Incorporated. In fact, during their remodeling procedure, they replaced conventional controls on their topping unit with TRANSMIT* Transmitters, TRU-ACT* Controllers and TRANSET* Recorders — the components of the Transet System.

"With TRANSET Control" says Vice President Everett E. Thompson, "we are having no trouble, for instance, in holding the Platformer transfer temperature at the desired figure. This is important, because of the effect of temperature on octane."

*Reg. Trade Mark

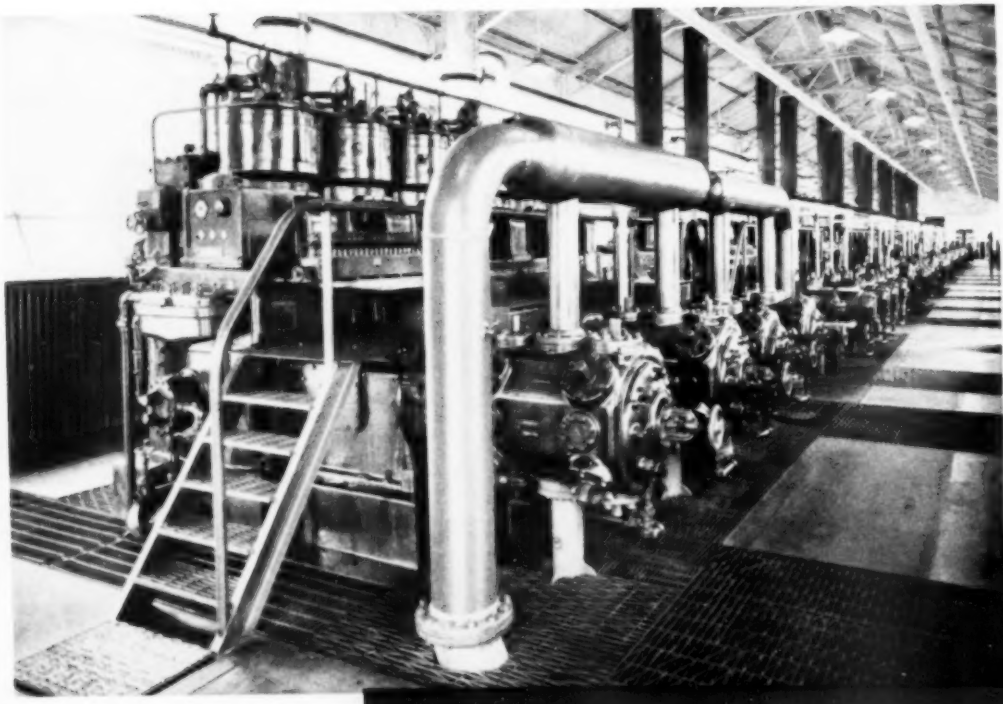
"The Platforming process under Transet Control has done an almost unbelievable job; we are able to turn out 90 to 95 octane gasoline, with 90% to 95% liquid yield from straight run," states R. J. Oosdyke, Vice President in Charge of Sales, "and this yield of top quality product puts Mid-West's White Rose gasoline in an extremely favorable competitive position."

This is just a single example of how Taylor's new TRANSET Control system is helping refiners get top quality product at minimum operating cost. Why not talk it over with your Taylor Field Engineer? Or write for **Bulletin 98097.** Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada. *Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.*

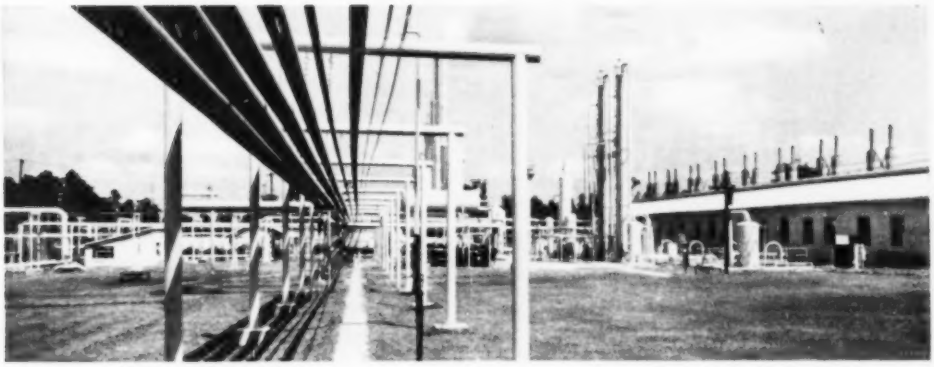
TAYLOR INSTRUMENTS MEAN ACCURACY FIRST

a mere .013" of power cylinder wear
after 10 years' full-load operation

...that's Clark



Eight Clark EB-6, 600 bhp Right Angle Compressors in Shelter, Arkansas natural gasoline plant of Ajax Oil Company



Compressor station (right) at Lion Oil Company's natural gasoline plant, Shuler, Arkansas

quality for you!

Clark "Right Angle" Compressors set remarkable record in Lion Oil Company operated Shuler Unit Natural Gasoline and Pressure Maintenance Plant

Power cylinder wear of less than .00125" per year after initial break-in! Total average wear of .013" per cylinder for the whole 10-year period!

. . . that's the remarkable record of six Clark RA-6, 600 bhp Right Angle, Gas-Engine-Driven Compressors operating continuously at full load since 1941 in Shuler Unit, Arkansas natural gasoline and pressure maintenance plant which is operated by Lion Oil Company.

But that's not all that's remarkable about this installation. The original power piston rings were in service for $8\frac{1}{2}$ of those years before needing replacement.

Two other Clark RA-6 units operating since 1943 and 1948 respectively, are showing the same unusual resistance to wear . . . the same extremely low maintenance.

That's Clark quality and durability for you!

There's a BIG difference in **CLARK**

COMPRESSORS

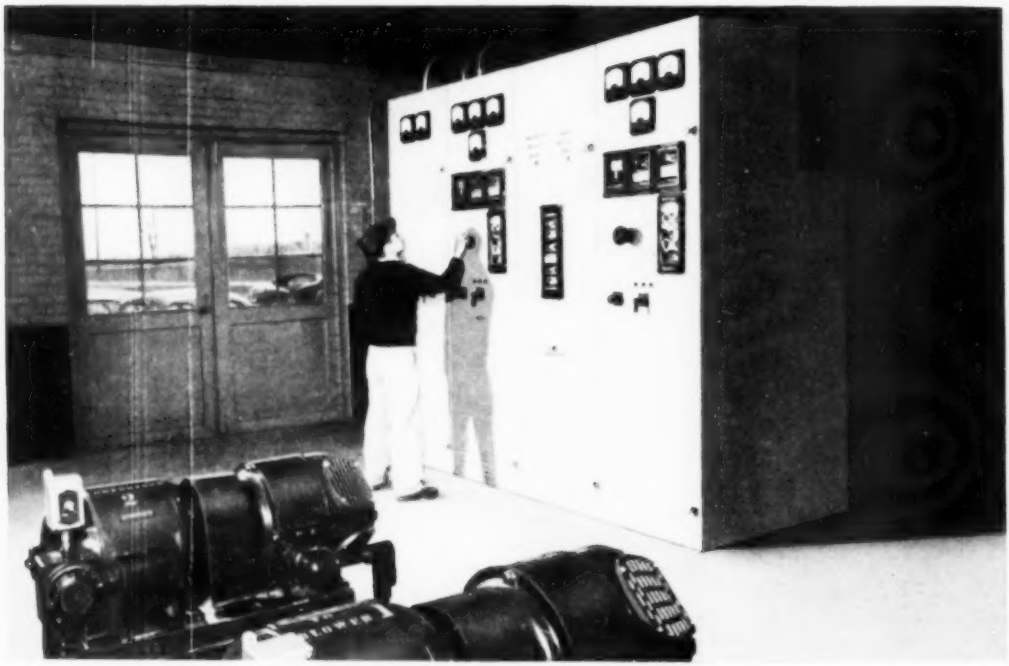
CLARK BROS. CO., INC. • *One of the Dresser Industries* • OLEAN, N. Y.

A PHOTO-REPORT ON MODERN

G-E equipment helps cat cracker operate 'round the clock!

Hazardous and corrosive atmospheres present no problem for plant's G-E explosion-proof motors

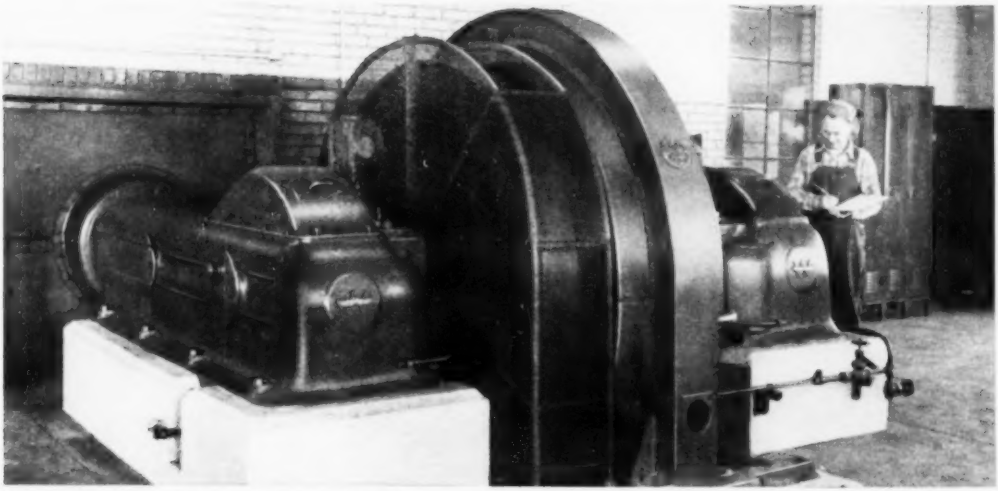
As part of a new construction program, Rock Island Refining Corp. recently added a fluid catalytic cracking unit to its refinery near Indianapolis, Ind. Here 12,000 barrels of crude per day are refined into kerosene, naphtha, gasoline and other products. Here G-E equipment—selected and applied for reliable operation in hazardous and corrosive areas—helps keep production going three shifts per day, 24 hours every day! And here, too, is more proof that G-E can handle any refinery electrification problem—including yours. See your G-E representative—early in your planning. *General Electric Company, Schenectady 5, N. Y.*



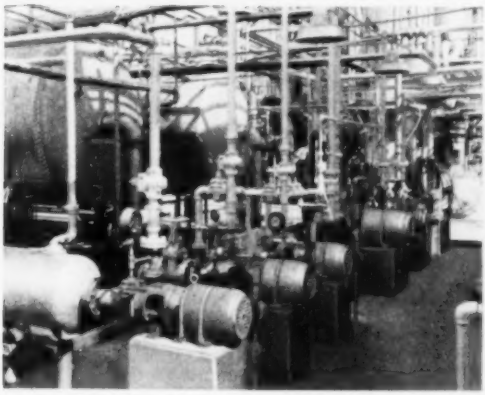
Installed in a non-hazardous area at Rock Island, this G-E metal-clad switchgear—a compact, space-saving unit—controls incoming 4160-volt a.c. power going to two synchronous motors in the refinery. The motor generator sets, in foreground, supply field current for these motors.

GENERAL ELECTRIC

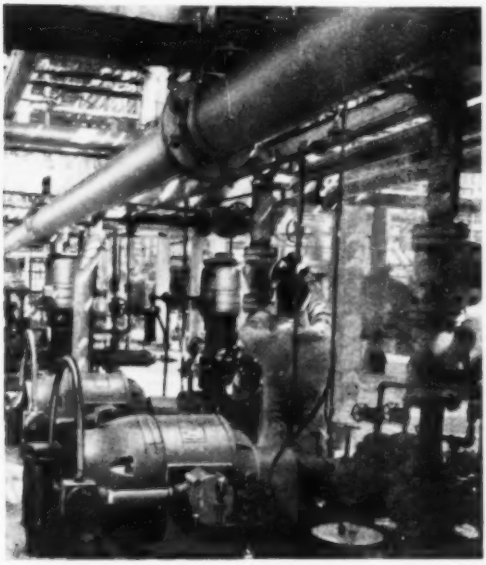
660-34



Proved dependability and minimum maintenance make G-E synchronous motors a top refinery choice. This G-E 400 hp 4160-volt synchronous motor drives two gas compressors in the fluid catalytic cracker.



Five of a kind—all G-E, all totally-enclosed explosion-proof—these motors vary in rating from 2 to 20 hp. They are used to "charge" gasoline and burning oils to Rock Island's treating plant, where objectionable odors and sulphur compounds are removed or transformed.

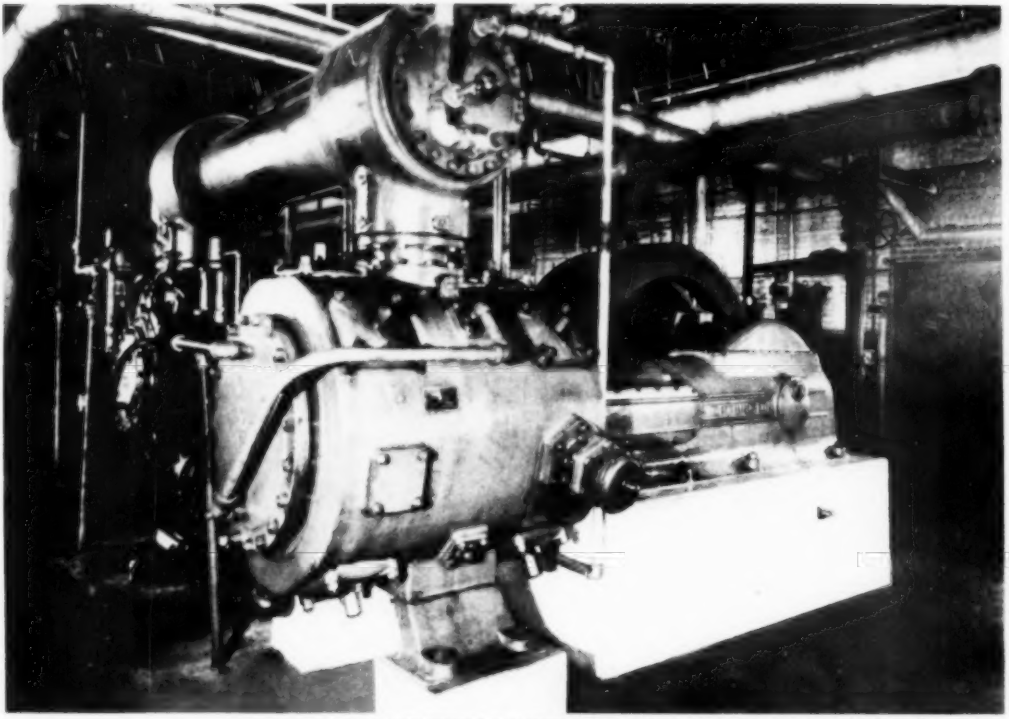


Corrosion and weathering doesn't harm G-E totally enclosed explosion-proof motors. At Rock Island, the two G-E 40-hp motors of this type in foreground drive crude charge pumps, while the two G-E 15-hp vertical motors of the same type in background drive pumps charging partially refined oil directly to the cracking unit.

New G-E Motor Selection and Application Course can help train your refinery employees, increase their efficiency. A G-E "More Power to America" program, it shows how motors work, types now in use, how to select and apply them for specific jobs. Write now for Bulletin GEA-4938-16 describing the course in detail.

Co-ordinated
ELECTRIC EQUIPMENT
for fluid catalytic cracking

(To obtain more data on advertised products see page 552)



ONE OF FOUR WORTHINGTON GAS COMPRESSORS in the gas distribution system of a large Eastern gas company. Compressor is positive displacement reciprocating type with capacity of 125,000 standard cu ft of manufactured gas per hour. Maximum discharge pressure is 100 psi. Volume is controlled by Worthington's automatic variable capacity control.

When a large Eastern gas company needed another gas compressor . . .

. . . There was no question about which make should be selected!

The gas compressor in the picture had been working so well since 1949 that Worthington was the logical choice for the *next* new compressor to handle expanded capacity.

These Worthington features constantly increase the number of such choices:

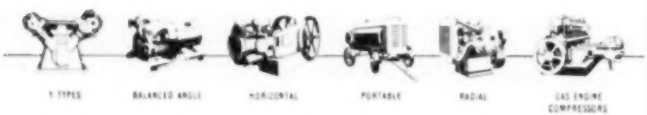
Accurate control of volume that is always assured with Worthington's automatic variable capacity control — acknowledged most accurate, flexible and simple control obtainable.

Worthington's exclusive Feather Valve* — simplest, lightest, most efficient ever made—eliminates valve problems. And Worthington's high-efficiency intercooler needs less water, less power, less attention.

Somewhere in the broad line of Worthington compressors, for air, gas or other "compressables", there is the one right type and size for your job. *Worthington Pump and Machinery Corporation, Compressor Division, Buffalo, N.Y.*

*Reg. U. S. Pat. Off.

K-215



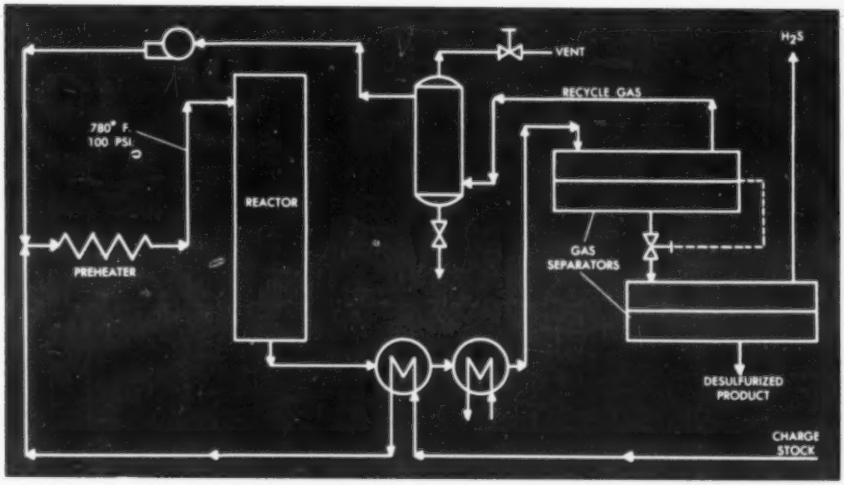
No Other Compressor Will Outperform a Worthington

WORTHINGTON

Compressors

New Autofining Process

Desulfurizes wide range of stocks with cobalt molybdate catalyst



THE Anglo-Iranian Oil Co. Ltd. of England has developed to the commercial stage a fixed-bed catalytic desulfurization process in which operating pressures and temperatures are controlled to produce sufficient hydrogen by the dehydrogenation of naphthenes in the feedstock for the conversion of the sulfur in the feedstock into hydrogen sulfide. No outside hydrogen is required.

Some excess hydrogen, in the gas produced in the process, is recycled to the desulfurization zone. Operating pressures are low, on the order of 50 to 200 psig, and temperatures are 700-800 F. Long on-stream time is said to be achieved for the catalyst, which is of the cobalt-molybdate type, and described as "very stable" and "sulfur resistant."

The process, called Autofining, is said to be applicable to a wide range of high-sulfur stocks, including straight-run gasolines and naphthas, kerosine, diesel fuels and gas oils. It is also proposed by the process to desulfurize distillates before their fractionation by distillation, or before catalytic cracking, and thus eliminate or greatly reduce the need for subsequent treatment of products for sulfur removal.

After an extensive laboratory development period, the process was further tested by Anglo-Iranian in a 350 b/d pilot plant, and a 3500 b/d commercial unit is now being built at the company's Llandarcy refinery in South Wales. The process has been patented in the U. S. and other countries. The basic reaction is described as follows in patents taken out in this country:

"It is believed that the reaction proceeds by dehydrogenation of some of the naphthenes to produce hydrogen in excess of that required to convert the combined sulfur present into hydrogen sulfide, and the reaction conditions for any particular feedstock must therefore be limited having regard to any limiting conditions imposed by these two reactions.

"Thus, there is a lower temperature of about 650° F. below which little dehydrogenation would occur and below which the reaction would not be self-supporting in hydrogen. This lower temperature depends to some extent on the sulfur content and the higher the sulfur content the higher the minimum temperature necessary to provide sufficient hydrogen. At temperatures above about 800° F., dehydrogenation occurs to such an extent that the product becomes increasingly aromatic. Furthermore, at temperatures above about 800° F. the on-stream time before regeneration is reduced.

"The preferred temperature of operation is to some extent dependent on the pressure employed, which is preferably between 25 and 500 psi. As the pressure is increased, the minimum temperature at which satisfactory dehydrogenation of the naphthenes can be obtained increases, and if at a fixed temperature the pressure is sufficiently increased, the reverse reaction of hydrogenation of aromatics begins to occur, e.g. at 650-700° F. and 500 psig.

"Thus, when operating at the higher pressures in the preferred range, it is desirable to use higher temperatures. Similarly it is desirable to avoid the combination of high temperature and low pressure, since such conditions (e.g. 800° F. and 25 psig.) lead to a short on-stream time for satisfactory operation."

"The space velocity may be varied according to the degree of desulfurization required, but space velocities above 10 v/v hr. result in a low degree of desulfurization."

Autofining for Sulfur Removal

Table 1—Autofining of Middle East Straight Run Gasoline and Naphtha

	Straight Run Gasoline		Naphtha	
	Feed	Product	Feed	Product
Distillation, °F				
[illegible]				
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[illegible]				
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By means of the Autofining process, straight-run gasoline and naphtha feed stocks with ASTM end points up to about 400 F can be almost completely desulfurized, it is claimed, and at the same time the octane number raised 2-3 numbers and the lead response improved. With these feedstocks catalyst on-stream periods of 800-1000 hours can be achieved. Table 1 gives typical results on Middle-East straight-run gasoline and naphtha.

Kerosines also are almost completely desulfurized by the Autofining process and catalyst on-stream periods of about 100 hours between regenerations are achieved. Burning qualities also are improved. Pilot plant results of feats on Middle East kerosine are given in Table 2. As applied to white spirits the process is said to yield a saturated product of good color, low sulfur content and improved quality for use, for example, as a solvent. The treatment of an unrefined Iranian kerosine is described in U. S. Patent No. 2,574,145 as follows (the numbers refer to the equipment shown in the flow chart on p. 467):

"An unrefined Iranian kerosine was fed to an autofining chamber 10 via line 11, heat exchanger 12 and preheater 13 where it was raised to a temperature of 780° F. at 100 psi. pressure. The reactor 10 was charged with a catalyst consisting of cobalt molybdate on alumina and the products leaving the reactor, after being passed in heat exchange with the incoming feed in heat exchanger 12, were passed to a cooler 14, where they were cooled under plant pressure, and then to a gas separator 15. The gases leaving the separator through line 16 were recycled to the reaction zone, in admixture with the incoming feed, via the booster 17, excess gas being vented from the system via line 18.

"The cooled liquid product from the separator 15, which contained all the H_2S in solution, was then reduced to atmospheric pressure in a further separator 19, in which the bulk of the H_2S was separated and removed from the system via line 20. The desulphurized product was removed via line 21. Gas was recycled to the preheater at a rate of 1000 cu. ft. bbl. The gas make amounted to 60 cu. ft. bbl. consisting of 70-80% by volume hydrogen, which was more than sufficient to maintain the recycle rate, the surplus gas being vented from the system."

Straight-run light gas oils (i.e. high speed diesel fuels) may also be desulfurized by this method. The degree of sulfur removal is lower than with lighter distillates, but in the case of Middle East crudes gas oils of 0.75 to 1.0% sulfur content can be desulfurized to the extent of 60-70%, with catalyst on-stream periods of 200 hours. Typical results are shown in Table 3.

In some refinery situations, the company announced, it may be found more desirable to desulfurize a long distillate and fractionate after processing, rather than to desulfurize separate products after fractionation. Results obtained when processing long distillates from Middle East and Slaughter, West Texas, crudes in this manner are shown in Table 4.

It is also proposed by Autofining to remove from gas oil and wax distillate catalytic cracking feed stocks sufficient sulfur to dispense with or substantially reduce the need to treat the product for sulfur removal. "Not only would the subsequent treatment of the products be more economical" it is stated in U. S. patent 2,574,149, but it would also be possible to utilize catalysts in the cracking operation which are poisoned by sulfur bodies. An example of the effect of the process on the products of catalytic cracking is given in the patent as follows:

"A gas oil feedstock of sulfur content 0.98% wt. was catalytically cracked over a synthetic silica-alumina gel at 55% Distillation + Loss Conversion to give a 430 F. F.E.P. gasoline having a sulfur content of 0.06% wt., and a residue above 430 F. having a sulfur content of 1.10% wt. After Autofining, this same gas oil feed stock had its sulfur content reduced to 0.2% wt. and this gas oil on catalytic cracking over synthetic silica-alumina gel at 55% D+L conversion, yielded a 430 F. F.E.P. gasoline with a sulfur content of 0.01% wt. and a residue with a sulfur content of 0.2% wt.

"As a second example, a wax distillate feed stock having a sulfur content of 1.77% wt. on catalytic cracking at 55 D+L conversion over a synthetic silica-alumina gel yielded a 430 F. F.E.P. gasoline of sulfur content of 0.13% wt., a gas oil (boiling range 430-655 F.) of 2.63% wt. sulfur content and a residue above 655 F. of 2.01% wt. sulfur content.

"This same wax distillate had its sulfur content reduced to 0.6% wt. on Autofining and this Autofined

Table 2—Autofining of Middle East Kerosine

	Feed	Product
Distillation, °F		
[illegible]		
[illegible]		
[illegible]		
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Table 3—Autofining of Middle East Virgin Gas Oils

	Feed	Product
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* The inspection data given refer to the total liquid product which contains a very small quantity of light ends. Removal of these light ends is easily accomplished in a simple flashing operation to give a product meeting specification flash point requirements.

feedstock when catalytically cracked under the same conditions as for the untreated material gave a 430 F. F.E.P. gasoline of sulfur content 0.05% wt., an intermediate gas oil cut of sulfur content 0.7% wt. and a residue above 635 F. of sulfur content of 0.7% wt.

"It is a feature of the invention that the products are suitable for use after only very light treatments. Thus, the C_4 and C_5 hydrocarbons need only be given an alkali treatment before being utilized for synthesis purposes. For example, they may be passed to a polymerization zone for the production of sulfur-free polymers. The gasoline need only be given treatment, for example, with clay or acid, to remove potential gum-forming constituents and redistilled for the production of finished gasoline. The fraction boiling within the kerosine range has a greatly reduced sulfur content and may be incorporated in heavy aromatic type blends, for example, power kerosine.

"If desired, heavy aromatic fractions may be separated from the cracked products and used for the production of semi-pure hydrocarbons.

"The gas oil fraction may be recycled to the catalytic cracking zone until it is destroyed. The recycle stock is frequently used as furnace oil distillate or as a diesel fuel component, and the recycle stock obtained by cracking an Autofined gas oil finds wider application in this respect in view of its reduced sulfur content."

Other materials which it is claimed may be satisfactorily desulfurized by the process include the highly aromatic extracts obtained by the solvent extraction of gasoline and kerosine fractions. Table 5 shows results of treating two aromatic SO$_2$ extracts. The process is not considered normally applicable to residual fuel oils containing asphalt.

"The preferred catalyst for use in the Autofining process", it is stated on one of the U. S. patents, "is of the so-called cobalt molybdate type, which consists of the oxides of cobalt and molybdenum deposited on or incorporated with a support, preferably alumina. It has been found that there is a period at the commencement of each run during which the gas make is negligible or non-existent and the desulfurization is not at its maximum.

"This low dehydrogenating activity of the catalyst is more noticeable at low feedstock velocities and with the heavier feedstocks. It was discovered that the inactivity of the catalyst during the early hours on-stream could be largely overcome by subjecting the cobalt molybdate catalyst to the action of hydrogen sulfide or hydrogen sulfide-containing gases prior to its use in the Autofining process."

Table 4—Autofining of Long Distillate From Middle East and Slaughter (West Texas) Crude Oils

Distillate from	Middle East Crude		Slaughter Crude	
Feed or Product, T.B.P., °F	332–660		204–602	
Yield of Product, % wt. on Feed	90.5		89.5	
Sulfur Removed, %	74.9		74.9	
	Feed	Product	Feed	Product
Specific Gravity, 60° F.	0.8660	0.8575	0.8286	0.8220
Gravity, °API	32.3	33.9	39.8	40.8
Distillation, °F.				
I.B.P.	332		204	243
5%	345		242	291
10%	367		248	317
30%	414		288	406
50%	454		324	504
End Point	660		602	626
Sulfur, %	0.243	0.06	0.16	0.04
Viscosity, Saybolt				
T.B.P., °F.	T.B.P. 660	T.B.P. 660	T.B.P. 550	T.B.P. 550
Yield, % wt.	44.8	42.9	39.4	41.6
Specific Gravity, 60° F.	0.7343	0.7260	0.7403	0.7350
Gravity, °API	61.0	64.2	60.5	60.3
Distillation, °F.				
I.B.P.	397	390	392	379
5%	424	410	428	420
End Point	667	661	560	564
Sulfur, %	0.091	0.002	0.102	0.0025
Sulfur Removed, %		97.8		98.2
Diesel Number (Motor)		44.0	47.6	52.0
Catalytic Reformer				
T.B.P., °F.	330–392	330–392	330–392	330–392
Yield, % wt.	10.7	11.3	10.5	10.4
Specific Gravity, 60° F.	0.7092	0.6973	0.7456	0.7439
Gravity, °API	68.6	72.7	58.5	58.9
Distillation, °F.				
I.B.P.	372	370	390	378
5%	380	378	396	384
End Point	418	417	418	412
Sulfur, %	0.243	0.015	0.054	0.017
Sulfur Removed, %		93.8		31.5
Naphtha Fraction				
T.B.P., °F.	182	182	182	182
Yield, % wt.	20.5	22.8	19.6	20.0
Specific Gravity, 60° F.	0.7410	0.7310	0.7720	0.7650
Gravity, °API	59.5	62.1	51.7	52.4
Distillation, °F.				
I.B.P.	190	187	190	191
5%	210	211	208	200
End Point	350	350	364	358
Sulfur, %	0.036	0.0	0.0	0.0
Sulfur Removed, %		71.2		75.5
Diesel Index		59	46	48

Engineers in this country have pointed out that a desulfurization process like this is highly important to Anglo-Iranian and other refiners operating abroad because of the relatively high sulfur crudes they use. This process would let them cut down on sulfuric acid for treating, while at the same time producing quantities of hydrogen sulfide which might economically be converted to either elemental sulfur or the acid.

The Autofining process is available through the Anglo-Iranian Oil Co. Ltd., London. Patents relating to the process issued in the U. S. are Nos. 2,573,726, and Nos. 2,574,445 through 2,574,451.

The 2500 b.d. Autofining unit now being installed at the Llandarcy refinery of Anglo-American Oil Co. will cost around $700,000 within battery limits. The anticipated consumption of utilities will be: 150-lb. steam, 6,600 lb./hr. net; cooling water, 30,000 Imperial gals./hr.; fuel, 25,000,000 Btu./hr.; electric power, 10 kilowatts. In this plant the recycle gas compressor will be steam driven and steam will be regenerated in a waste heat boiler.

The Llandarcy unit will have several reactors operating in cycle, so that in effect it will be a continuous

Table 5—Autofining of Aromatic SO$_2$ Extracts

	Extract from Middle East Naphtha		Extract from Middle East Kerosine	
Yield of Product, % wt.	97.5		97.0	
Sulfur Removed, %	58.6		92.5	
Catalyst on-stream period, hrs.	200		200	
	Feed	Product	Feed	Product
Specific Gravity, 60° F.	0.870	0.855	0.869	0.864
Gravity, °API	31.8	34.0	31.3	32.3
Distillation, °F.				
I.B.P.	229	230	311	286
5%	246	243	329	314
10%	248	246	338	327
30%	264	261	372	369
50%	283	283	431	431
End Point	328	327	489	496
Octane Number (Motor)	65.2	67.2		
Aromatics, % wt.	78.1	76.2	73.0	73.8
Color, Saybolt	+15	+27	0	22
Sulfur, %	0.295	0.004	0.092	0.052

This Story Tells . . .

. . . What problems are involved in the blending of motor oils — accuracy, contamination, moisture.

. . . How serious these problems are in the old-fashioned tank blending process (Fig. 1).

. . . How they have been eliminated in more modern processes—tank blending with meters (Fig. 2), and continuous automatic blending (Fig. 3).

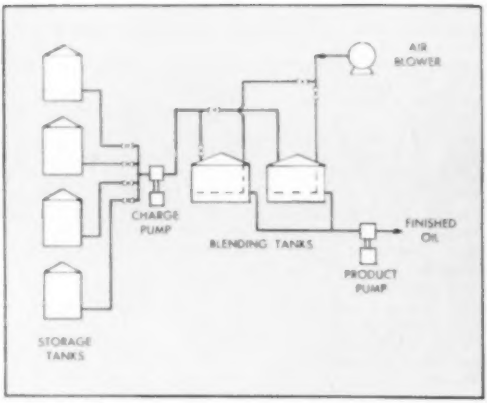


FIG. 1—Old fashioned batch method of blending motor oils

Blend Motor Oils the Modern Way

Continuous automatic blender solves problems of batch method—accuracy, contamination, moisture

By R. G. ATKINSON
Chief Process Engineer,
No. 2 Refinery
Standard Oil Co. (Ohio)

MOTOR oil blending is a very simple operation. It involves no complex chemical reactions and no complicated mathematics or long equations. However, many of the components of a motor oil are expensive and very exacting accuracy is necessary if specifications are to be met, uniform quality maintained and costs kept competitive.

Until recently Sohio blended motor oil by about the same method that the housewife uses to bake a cake. The equipment used consisted of a tank with a steam coil and an air sparger in the bottom. The ingredients were pumped in one after another. The amount of each ingredient was measured by gaging the tank after each transfer or by using separate small gaging tanks for small ingredients. Let us take, for example, an SAE 30 motor oil which has the following composition:

S.E. Neutral	54.65%
S.E. Bright	29.60%
Component C	2.20%
Component D	13.00%
Component E	0.25%
Component F	2.1 gm. bbl.
Component G	0.6 gm. bbl.

Of the seven components the solvent extracted neutral and the solvent extracted bright stock are the base ingredients. Component C is used to improve the viscosity index. Component D imparts detergency and antioxidation characteristics. Component E darkens the oil and gives it a very pleasing caste. Component F is a masking agent which covers up the characteristic odor of the other components. Component G is an anti-foam agent.

A flow diagram of the facilities required to blend this motor oil by the old fashioned method is shown in Fig. 1. Note that there is a storage tank for each major ingredient. There are suction lines from each storage tank to the suction manifold of a charge pump. The same charge pump is used to pump each major ingredient. The blending tanks are large in diameter and short in height.

The old fashioned procedure for blending a motor oil using these facilities could be as follows:

1. Pump in solvent extracted neutral.
2. Pump in solvent extracted bright stock.
3. Pump in component C.
4. Heat to 180° F., and blow until dry.
5. Pump in component D.
6. Pump in component E.
7. Add component F by hand.
8. Add component G by hand.
9. Blow for 15 min. to mix well.
10. Pump away on laboratory approval.

Note that after the first three components have been pumped in, the batch is heated and blown with air until all traces of moisture have been removed. This is to avoid deteriorating any of the components by prolonged heating and blowing in the presence of moisture. Note that the very small ingredients are weighed out and added by hand. This entire procedure is very simple unless we become concerned about accuracy.

The most obvious source of error is in gaging. The best accuracy that can be expected is $\pm\frac{1}{8}$ in. In the usual tank for motor oil blending, the error is approximately $\pm$ 1.67%. The error in any one component may be as much as 0.67% of the total batch. The sketch below shows what this may mean in the case of a small component.

	MIN. %	MAX. %	% ERROR
COMP. D	12.7	13.3	±3
SEB	29.3	29.9	±1
SEN	54.5	54.8	±0.3
COMP. C	2.1	2.8	±14

For component C, the error is ±14%. For a 30,000 gal. batch this error represents $280.00. This is roughly ± 1c gal. For component D, the error is ±3%, or $200.00. These are substantial sums to have hidden between the marks on a gage pole.

A second source of error is due to changes in temperature. In actual practice we would usually like to start heating the charge in the blending tank as soon as the steam coil is covered. To do so shortens the time required for blending a batch.

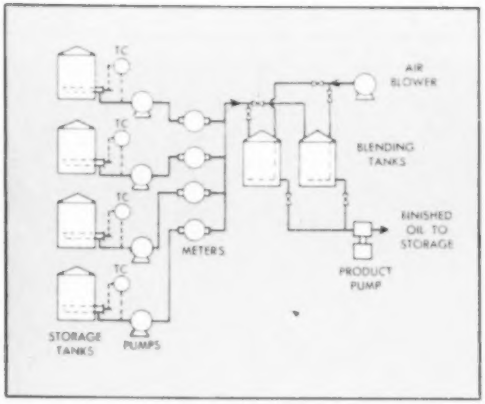


FIG. 2 Improved batch method of blending, using separate pumps, lines and meters for each component

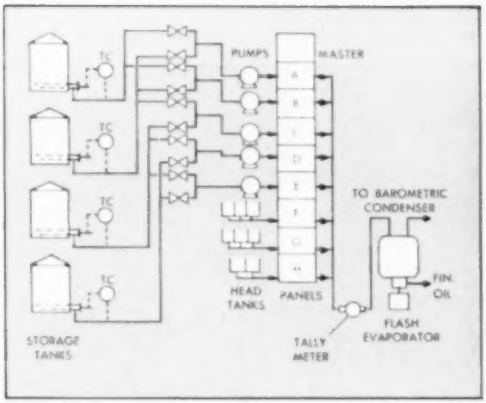


FIG. 3 Flow diagram of continuous automatic blending unit

The actual effect is not serious until the small components near the end are reached.

Let us assume that we put components C and D on our batch of motor oil last and that the temperature of the balance of our batch changes 50° between the "before" gage and the "after" gage. The effect on the amount of these components added is shown below.

	DESIRED %	ACTUAL %	% ERROR
COMP. D	13.0	12.8	−1.5
SEB			
SEN			
COMP. C	2.5	2.3	−7.0

Of course these errors may be eliminated by measuring the temperature of each gage and correcting for temperature. An even more fool-proof method is to use gage tables that show only standard gallons at 60° F.

The third source of error in tank blending is contamination. There is always a question whether the material pumped is the one desired or some of the previous component left in the lines and pump. Of course, this could be remedied by having completely separate lines and pumps for each component.

Batch Blending with Meters

A consideration of the sources of errors just discussed suggests that batch blending could be considerably improved by having:

1. Separate pumps for each component.
2. Separate lines for each component.
3. Meters for each component.

The meters used may be automatic temperature compensating type or they may operate on constant temperature streams. In actual practice it is usually necessary to heat most of the streams in order to obtain satisfactory pumping conditions. It is also necessary to control the temperature of the stream rather carefully to avoid over heating at certain conditions. Therefore, the added cost of automatic temperature compensating devices is usually not justified.

The flow diagram of a motor oil blending unit using meters with separate pumps and lines for each component is shown in Fig. 2. For each component there is a suction heater in the tank, a temperature controller on the steam to the suction heater, a completely separate pump, line and meter. Very small components would still be added by hand on a weight basis. These facilities eliminate the problems of gaging errors, temperature errors and contamination. They may also reduce the time required for blending a batch because all components may be pumped into the blending tank simultaneously.

Problems with Tank Blending

Both of these blending procedures described so far have two objections. In the first place, they are batch processes. They require the use of a tank into which all components may be pumped for mixing. After mixing and testing, the finished batch must be pumped away before the blending tank may be used for another batch. The blending cycle is inevitably long. At least three or four blending tanks are required if any reasonable number of batches are to be made per week.

A second objection to this type of blending arises from the presence of moisture in some or all of the stocks. This moisture must be removed before the batch is finished. The trade demands a bright clear product for motor oil and most industrial oils. As much as 0.02% of water will cause most oils to be cloudy at atmospheric temperature. It is not sufficient to have an oil bright when it is blended. It must be bright when it reaches the ultimate consumer. Most oils will pick up some moisture in normal storage and handling. Therefore, when an oil is blended it must be sufficiently dry so that it may pick up the normal amount of moisture during storage and handling and still remain bright.

In the past it was normally necessary to heat the batch to a minimum temperature of 180° F. and blow with air for several hours to dry the oil. This prolonged heating and blowing sometimes darkens the oil so much that the finished batch will not meet color specifications. The combination of moisture and high temperature was also injurious to some additives.

Some time ago, a study was made of our lube oil drying process. We found that we were using very nearly saturated air to attempt to dry the oil. Frequently, we were actually using super-saturated air that increased the water content of the oil we were trying to dry. The problem was readily solved by the installation of an air heater which raised the temperature of the air so that even after expansion through the air spider the relative humidity of the air was very low. It was found that by the use of warm air practically any oil could be dried to a satisfactory water content with four hours blowing at 150° F. Under these conditions the loss of color was practically negligible.

Continuous Automatic Blending

All of the foregoing problems associated with batch blending are eliminated by the continuous automatic blender. A simplified flow diagram of this unit is shown in Fig. 3. The storage tank for each component has a suction heater. There is a temperature controller on the steam to each suction heater, set to maintain a temperature of 150° F. The suction lines are insulated and steam traced where necessary to assure adequate suction conditions. The manifolds and pumps are located on the floor below the blender.

The blender itself consists of a master panel, five component panels

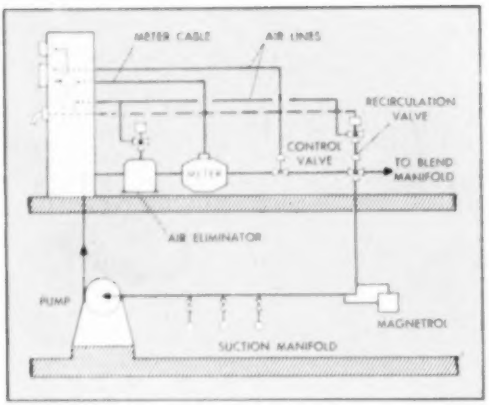


FIG. 4 Details of a component panel for the continuous automatic blender

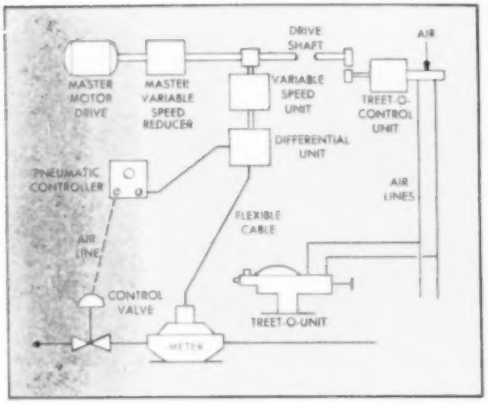


FIG. 5 Flow control system for component and additive panels

and three additive panels. A detail of a component panel is shown in Fig. 4. Each component panel consists of a pump, a pneumatic controller, an air eliminator, a positive displacement meter, a control valve and a three-way recycle valve.

Fig. 5 shows diagrammatically how the flow through all panels is controlled. The master panel contains a synchronous drive motor and an infinitely variable speed reduction unit. The output shaft from the speed reduction unit drives one shaft of a differential in each component panel through an infinitely variable integrator. The second shaft of the differential on each component panel is driven by the component meter. Whenever the meter is driving one shaft of the differential at exactly the same rate as the other input shaft is being driven by the master panel, there is no motion from the third shaft of the differential and the component is flowing at exactly the correct rate. Whenever the rate of rotation of the two input shafts is different, some rotation will be produced in the third shaft. This rotation will cause the controller to change the air pressure on the flow control valve and bring the flow through the meter back to the proper control point.

The additive panels operate somewhat differently. The drive from the master panel determines the number of strokes per minute of each Treet-O-Unit. A Treet-O-Unit is essentially an air actuated simplex reciprocating metering pump. The setting on each panel determines the length of strokes in hundredths of an inch.

To put the unit on stream, the operator sets all totalizers to zero, puts the proper setting on each panel to be used for the blend, so that the total of all rates will add up to 100 gpm., lines up the proper tanks, valves and pumps, turns the switch on the master panel to "re-cycle" and lets the unit operate until all flows level out. Then he turns the switch on the master panel to "test" for exactly 10 min. At the end of the 10 min. he turns the switch to "totalizer reset" and reads each totalizer. With the master panel set for 100 gpm., totalizer should read the percentage of that component in the blend.

If all the component panels are operating correctly, the next step is to check the additive panels to be used by determining the rate at which they pump from the calibrated gage glasses. When every item has been checked, the master tally meter is set for size of batch desired, the discharge lines are opened, the totalizers are reset to zero and the switch on the master panel turned to "blend". Each component is discharged through the manifold and the tally meter to storage. If at any time during the run a component pump loses suction or the flow of any component gets out of control by more than a predetermined amount, the entire blender will automatically be thrown on re-cycle. When the predetermined number of gallons has been blended through the tally meter, the unit is automatically thrown on "re-cycle".

At the end of a run any or all component panels may be cleared of the oil that is in them by throwing the switch to "blow back". High pressure air is automatically admitted to the air elimination chamber. All oil is blown out of meter, lines, valves, pumps, and suction manifold back to the tank. When the suction manifold is free of oil, a magnetrol on the suction manifold will operate and turn on a light which shows that "blow back" is completed. The operator then closes the valves to that tank and proceeds to line up another stock, if he desires.

Another part of the continuous blender which we have not discussed is the flash evaporator, installed to remove moisture from the oil blend and to assure thorough mixing of all components. Fig. 6 shows a drawing of the flash evaporator and its auxiliaries. The evaporator consists of a pressure vessel 4 ft. in diameter with a centrifugal pump in the bottom. Oil is introduced at the top and flows on to a rapidly rotating disc, which throws the oil to the outside of the vessel in a sheet only four thousandths of an inch thick. Any moisture is vaporized and passes out to the barometric condenser. The steam jets remove any non-condensable gases and maintain the pressure in the evaporator at about one and one half inch of mercury absolute. The centrifugal pump in the bottom of the evaporator discharges the dry oil to storage.

The continuous blender has been in operation at Sohio's No. 2 Refinery since early in 1950. During the first five months of operation, 125 batches of motor oil were blended through it. These batches covered 13 different grades of motor oil. Total throughput was 3,000,000 gals.

The following data show how well

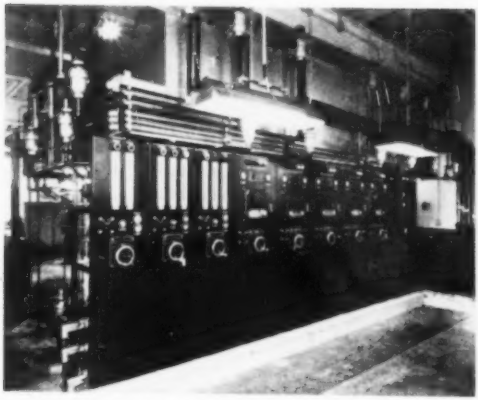
Table 1—Continuous Automatic Blender Performance Data

Component	Gal. of Component Consumed Based on Blender Data	Based on Tank Gages
A	5,270	5,237
B	7,280	7,225
C	82,955	83,705

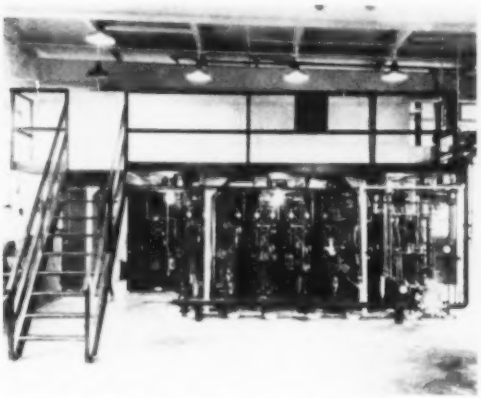
Table 2—Flash Evaporator Performance Data

Stock	—Water, wt. %— In	Out
S.R. Neutral	0.111	0.0156
S.R. Neutral	0.020	0.0008
S.R. Bright	0.028	0.013
S.R. Bright	0.029	0.012

(Operating Data: 100 gpm., 180-170° F., 3.5 in. Hg abs. pressure)



CONTINUOUS AUTOMATIC BLENDER installed at Sohio's No. 2 Refinery. Master panel is at extreme right, five component panels in center, and three additive panels at left.



REAR VIEW of automatic blender assembly, showing array of valves and other controls. Main discharge line is in lower foreground, with tally meter to the right.

the blender has performed its job on two different batches of the same blend.

Panel	Batch 8129 Gal.	Batch 8131 Gal.
A	21,650	21,646
B	4,467	4,463
C	2,992	2,952
D	356	352
E	617	608
F	32	29
TOTAL	30,054	30,050

These data were not obtained by engineering test. They represent what our operators have been able to do in the routine performance of their work. These two batches were selected at random from our blending data sheet records. A different motor oil requiring different stocks and different settings was blended between these two batches. It is apparent that the equipment will reproduce the same results very accurately.

The continuous blender makes it possible for us to check and double check on our blending operation. Table 1 shows a comparison of the amount of a few components consumed based on data from blender data sheets and changes in stock tank inventories. There is a very close check between the gallons consumed based on blender data and actual tank inventories plus receipts. The job done by the blender appears to be just as accurate as its machinery says it is.

Table 2 shows some typical performance data on the flash evaporator. Any water content in excess

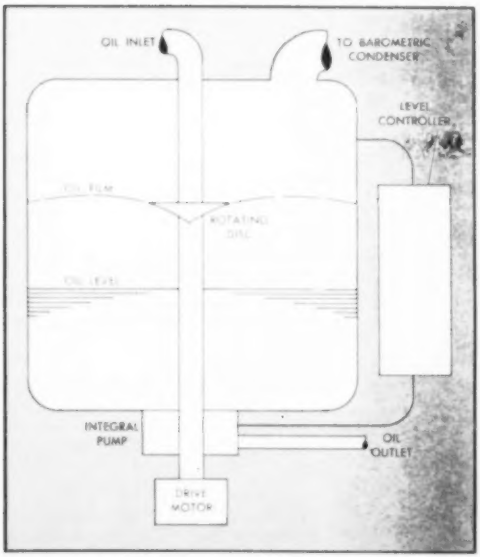
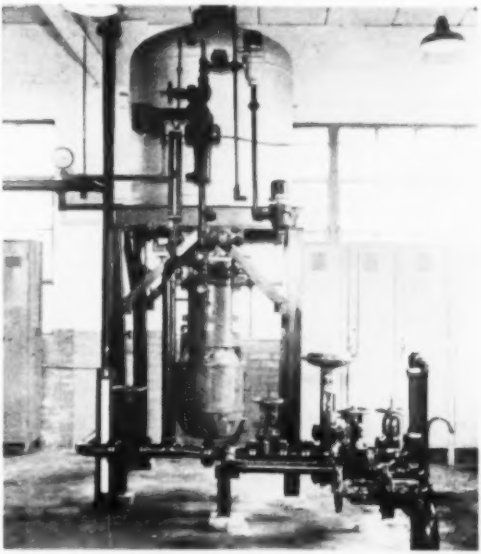


FIG. 6 Internal arrangement and auxiliaries for flash evaporator.



FLASH EVAPORATOR used to remove moisture from the oil blend. Fig. 6 shows the internal arrangement of this equipment and its auxiliaries.

of .015 wt-% will fail to pass the "hot cup" test. In this test oil is poured into a red hot flash cup. The presence of moisture is indicated by the "pops" which occur when tiny drops of water come into contact with the hot cup. The amount of water required to form a cloud in an oil is normally somewhere in the range of .020 wt-% or above. The data given in Table 2 indicate that the evaporator is capable of drying oils of normal water content and the most common viscosity ranges to a degree of dryness that is entirely adequate for normal storage and handling. The performance of the unit on routine batches appears to be equal to or better than that obtainable by the use of hot air drying.

Summary

We have described three possible methods of motor oil blending. If all three are compared, it appears that simple tank blending has no place in modern motor oil blending processes. There are still many places in the petroleum industry where simple tank blending is perfectly satisfactory. Furnace oil blending is a good example. Here the two components being blended are comparatively similar in most respects, there are usually only two components and the amount of the smallest component used is usually at least 20% of the batch. Under such circumstances it would be practically impossible to justify any more accurate facilities.

But modern motor oil blending should be done by either tank blending with meters or the continuous automatic blender. Table 3 shows a comparison of these two processes. Since both processes depend on positive displacement meters operating on constant temperature streams, both should have the same degree of accuracy under normal conditions.

The continuous automatic blender is definitely more fool-proof. The mechanical features built into the continuous automatic blender make it subject only to human errors. The operator may still open the wrong valve on a manifold, put the wrong setting on a panel, or fail to properly check the calibration during the test run. The system using meters alone is subject to the same human errors, but it has one other. If the pump supplying one meter should lose suction the meter would still put in the predetermined volume but it could be air instead of oil. The operator would never know the difference until he discovered that the batch in the tank was smaller than it should be. If a pump on the continuous blender loses suction, all panels will be thrown on re-cycle automatically until the operator corrects the trouble.

Since there is some hold up in the manifold and in the flash evaporator, the continuous automatic blender has a definite limitation with regard to minimum batch size. In Sohio's continuous blender this is about 1,500 gals. Several 5,000 gal. batches have been blended without detecting any trace of the previous batch. We feel certain we could go down to 1,500 gals. with no trouble, but this is probably the lower limit. A similar finite limit exists for simple tank and meter blending. In the latter system, however, if a proper assortment of tank sizes is available, the lower limit may be considerably reduced because the manifolding is much more simple.

One of the outstanding advantages of the continuous automatic blender is that it may start producing a completely finished motor oil on very short notice. In actual practice we have found that it takes about ½ hr. to line up all panels, make the calibration run, and get ready to go on stream. Of course, the first time we run a new blend we may spend half a day getting the proper settings.

We have found that the blender is more than accurate enough for the leeway allowed in most of our formulas. We have had to feel our way into the proper setting by blending 500 gals. according to usual formula and sending a sample to the Control Laboratory for test. When we get their results, we make some adjustments, blend another 500 gals., get the laboratory tests on that, and continue in that way until we have every specification where we want it. On the next batch we can put the same settings on each panel, test for calibration, and go on stream with only routine laboratory checks.

We feel that we can, if necessary, blend directly into tank cars, tank wagons or storage tanks without going to rundown tankage. We could start pumping finished oil into a tank car 30 min. after we get the order. Furthermore, we could set the master tally meter for the desired number of gallons, blend it, blow out the line into the tank car, and have not a drop to waste. Any system that uses tanks for mixing the ingredients cannot possibly respond to orders this quickly. Where tanks and meters are used for blending, no shipment of finished motor oil could normally be made in less than 6 or 8 hrs. after the order was received. In the past this has always meant that we were forced to use storage tanks for all motor oils that had to be shipped on short notice.

Any attempt to mention capital costs in a general comparison such as this is bound to raise questions. It should be sufficient to point out that a system of tanks and meters requires more pumps and more meters but less manifolding. The continuous automatic blender requires less pumps and meters but more expensive controls on the pumps and meters. There may be many installations where the costs would be substantially the same.

There is no reason why the operating costs for utilities, labor, or maintenance should be different in the two cases being compared. The peak utility loads are liable to be higher for tank blending if comparable operating capacity is to be considered.

One factor often overlooked in comparing two processes is that of ease of expansion to obtain increased capacity. In this respect the continuous blender has the advantage. The basic panels and controls are the same regardless of the size of meters which are connected to them. Frequently considerable increase in capacity of a continuous blender may be accomplished by simply increasing the size of one or two meters. On the other hand to increase the capacity of a blending system using tanks and meters requires additional tanks, real estate and piping.

Each of the blending processes has specific applications depending on the circumstances.

Table 3—Comparison of Blending Processes

	Tanks and Meters	Continuous Automatic Blender
Accuracy	Same	Same
Foolproof	No	Yes
Batch Size Flexibility	No Practical Limit	Finite Minimum Size
Batch-to-Batch Contamination	Almost None	Small but Finite
Blending Cycle	6 Hrs. + Pumping Time	½ Hr. + Run Time
Capital Cost	Slightly Lower	Slightly Higher
Operating Costs	Same	Same
Ease of Expansion	Difficult	Good

Meet the Author

R. G. Atkinson received his master's degree in Chemical Engineering from the University of Michigan in 1939 and then went to work for Standard of Ohio as a Junior Engineer in Technical Service. He's been with Sohio ever since, except for a 5-year break that he spent in the Army. Two years ago he was transferred from Tech Service to the company's No. 2 Refinery in Cleveland, where he is now Chief Process Engineer.

How to Make Brass Liners Work

By WILLIAM C. UHL
Equipment Editor

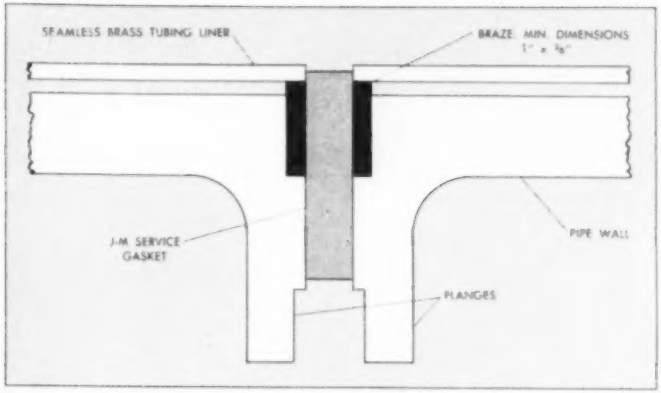


FIG. 1—SECRET OF SUCCESS in brass lining method is use of hidden joints as shown in these brazes in straight pipe

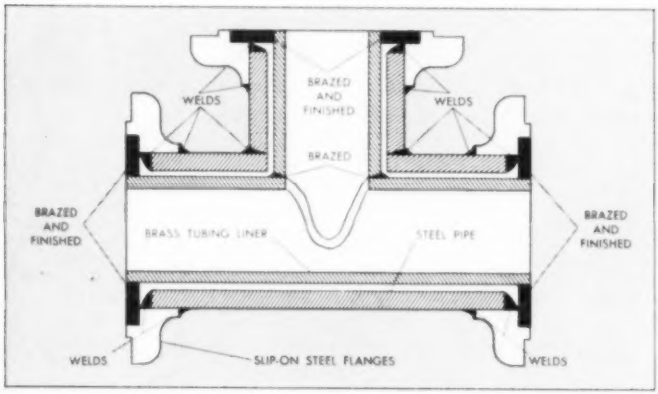


FIG. 2—NO CONTACT WITH CORROSIVES can occur at any braze in this shop-fabricated pipe tee

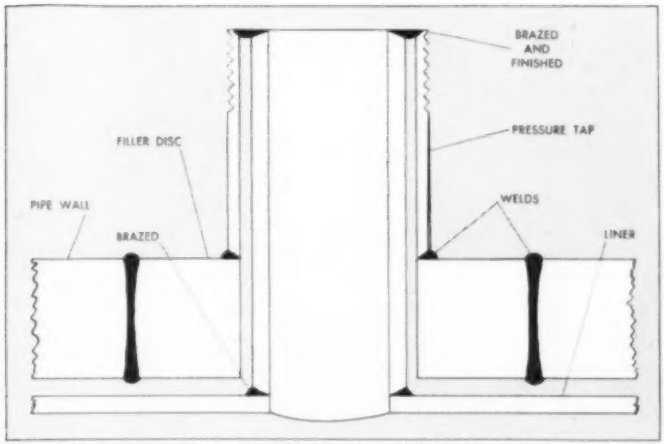


FIG. 3—PRESSURE TAPS TOO can be brass lined successfully

BRASS linings can be used to provide satisfactory corrosion resistance in lines and vessels carrying gasoline liquid and vapor. This has been proved out in a successful, long-term program by Sun Oil Co. to develop a lining technique for this kind of equipment. Some linings have been in use over a decade at the Marcus Hook, Penn., refinery; others have seen at least three years' service.

Sun liked brass. Its qualities for corrosion protection were well recognized. However, it often presents difficulties, both in the initial installation and in subsequent operation. Chief obstacle has been that brazed joints are a weak point—tending to fail long before the parent metal.

The solution to the problem seemed obvious enough—eliminate all brazed joints possible or else cover them up so they're not exposed to the corrosive fluids. That was, of course, a lot easier in the telling than in the doing.

But it has been done. And the accompanying sketches show some of the methods Sun worked out and applied in lining process lines, vessels, and fittings. Fig. 1 shows the method used for the simplest job, lining a straight length of flanged pipe.

Seamless brass tubing of the same length as the pipe and a diameter slightly less than the pipe I.D. is inserted and then brazed at each end as indicated. Thus, a minimum of brazed joint is exposed, being completely covered by the flange gaskets. No. 16 BWG tubing of the following brasses is used: yellow, high zinc, Muntz metal, naval or Admiralty. Short spool pieces and standard elbows are lined in the same manner as the straight pipe.

Tees were a little tougher to line and still keep the brazed joints protected. Sun licked this problem by making up fabricated tees, as shown in Fig. 2. The fitting and liner must be assembled at the same time, as follows:

1) The main piece is made up by welding slip-on steel flanges to each end of a length of steel pipe. 2) The hole for the side opening is cut to the same diameter as the I.D. of the side-leg pipe. 3) The seamless brass lining tube, of the proper length, is inserted and brazed into place, using the technique shown in Fig. 1. 4) A hole is cut through this liner to the same diameter as its I.D. and concentric to the hole in the pipe wall. 5) The liner for the side-leg is then secured, putting the braze on the side of the joint away from the interior of the fitting (thus protecting it from the corrosive fluids). 6) The side-leg is welded on along with its flange.

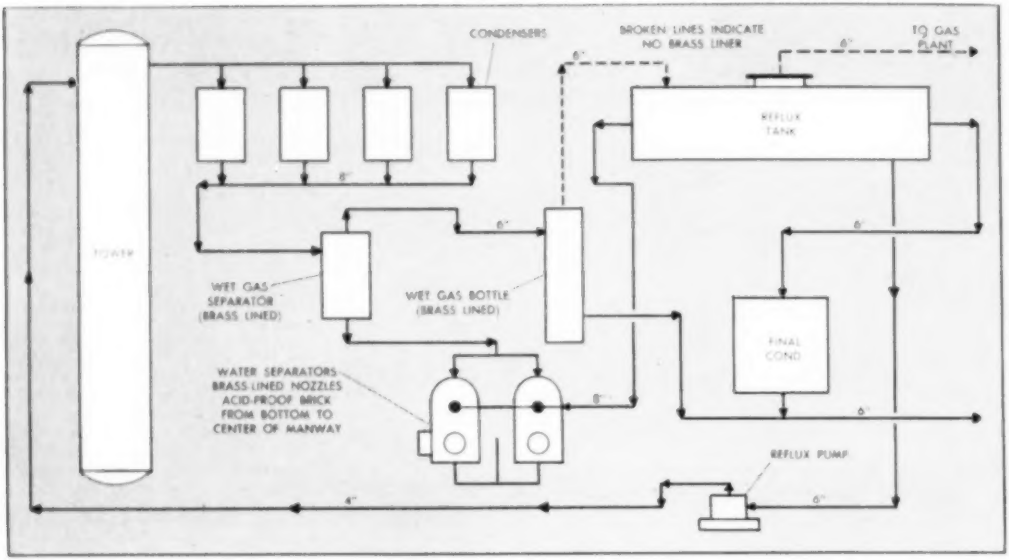


FIG. 4—ALL "WET" OVERHEAD lines in the crude unit were protected with brass

and the outer end of the sideleg liner is then brazed.

Smaller fittings, such as those required for instrumentation, can be handled by similar techniques. One method for installing pressure gage taps is about the same as that for the fabricated tees. It is illustrated in Fig. 3. Assume a tap is to be located in a length of straight pipe which has already been brass-lined. First, a 2 to 3-in. hole is trepanned in the pipe wall. Then a small hole is cut into the liner, concentric to the larger hole and of the same size as the I.D. of the liner to be used in the tap.

This smaller liner is then brazed to the larger liner. Then a steel filler disc (or washer, actually) is welded in place as indicated, and the pressure gage line is welded to it. Final operation is to braze together the smaller brass liner and the pressure tap at the outer, threaded end.

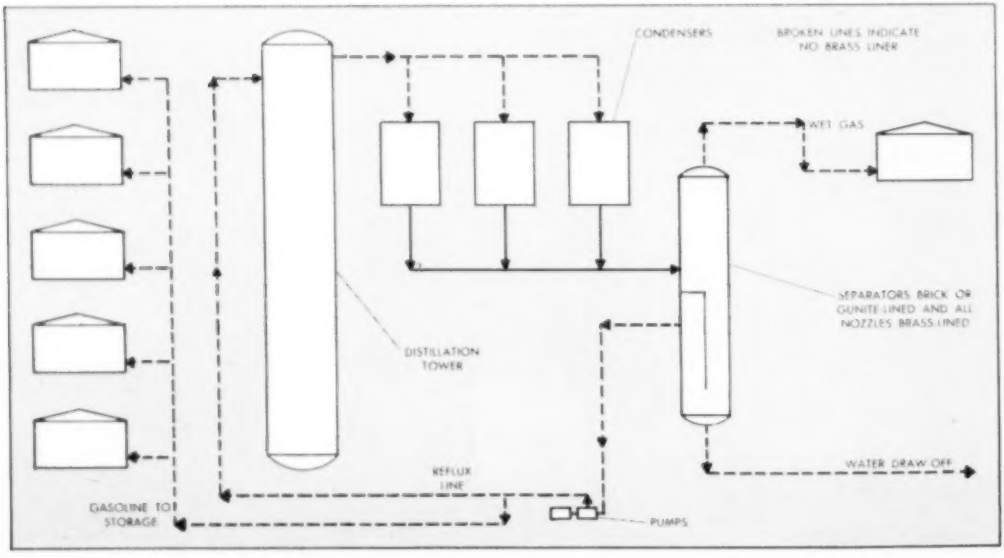


FIG. 5—IN CRACKING UNITS, lining was needed only between condensers and separators

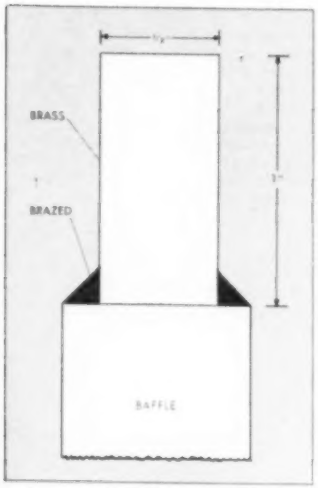


FIG. 6—ADDED PROTECTION was obtained on condenser baffles

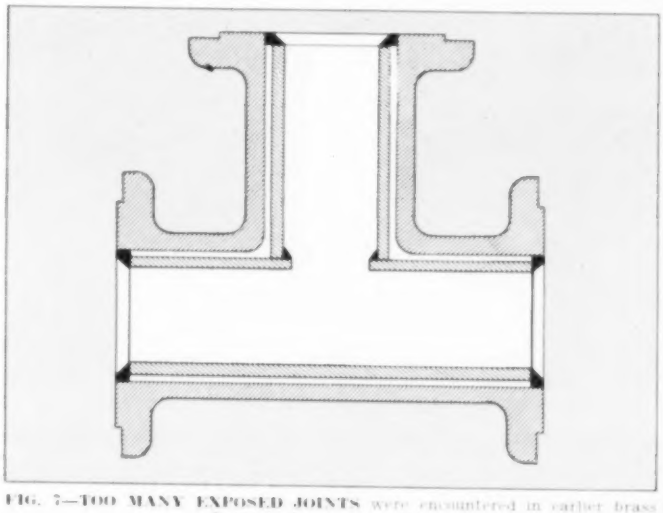


FIG. 7—TOO MANY EXPOSED JOINTS were encountered in earlier brass lining techniques on fittings

Another technique for installing a pressure tap is relatively simple in the actual installation but requires careful advance planning. It involves the use of a so-called "dutchman," inserted between flanged ends of sections of pipe. The dutchman is an extra steel disc of the same thickness and diameter as the flange and pierced with a hole of the same ID. The pressure tap is made through the edge of this plate.

Schematic flow diagrams in Figs. 4 and 5 show where the brass-lined pipe and fittings have been used at Marcus Hook. They are used on all liquid gasoline lines in crude fractionation, and in thermal and catalytic cracking, and also on any vapor lines where the corrosion rate has indicated a need.

On the crude unit, in addition to the various overhead and reflux piping, brass lining has been used on the wet gas separator, wet gas bottle, and the water separator nozzles. In the case of the cracking units, the lining was necessary chiefly in the piping between the overhead condenser of the distillation tower and the wet gas separator. As in the case of the crude unit, the separators are lined with brick or Gunite and the separator nozzles are lined with brass.

The protective property of brass has also been utilized on overhead condensers, where brass was installed as the leading edge on the baffles of the condenser doors. The technique, illustrated in Fig. 6, consists of brazing a strip of brass 1 in. wide by ⅛-in. thick along the edge of the baffle. Brazed joints will stand up well if they are machined smooth.

As explained earlier, Sun engineers had always recognized the value of brass in fighting corrosion. The problem had been to make it work as a lining material. Briefly, the development of the idea has gone along like this:

The first thing tried was to roll thin, flat brass strips into troughs which were inserted in the lines. The theory was that the strongest corrosion attack was on the bottom half of the line and definitely in the liquid phase of the fluid flowing through the line. Troughs were not fastened but merely laid in place.

The only result of this first experiment was that the brass served as excellent "test specimens," proving what was already known—that brass will withstand this type of attack.

Next, complete cylinders were rolled from the sheet brass. They were made of the proper diameter to fit inside the pipe, and brazed along the longitudinal seam. Two things went wrong: 1) the braze was exposed to the gasoline and failed rapidly, and 2) gasoline would seep in between the cylinder liner and the pipe wall. At higher temperatures the liquid gasoline vaporized, building up pressure and finally collapsing the thin brass tube, consequently plugging off flow.

At this time, Sun also tried lining fittings by paddling brass rod onto the inner walls. It was found that the rough surfaces of the braze, both in the fittings and in the cylinder seams, caused too much turbulence of the corrosive medium. As a result, even though the brass could withstand attack under conditions of relative quiescence, the slag would corrode into the brass rapidly when the gasoline was agitated.

An earlier technique for lining fittings—and one which still must be used, for example, in a conventional rather than a special fabricated tee—is shown in the sketch in Fig. 7. While fairly satisfactory in service and considerably simpler to assemble, it has the disadvantage of too many exposed brazes.

Before Sun began using brass liners they had been faced with the continuous expense of completely dismantling lines during every shutdown so as to permit thorough visual inspection. In addition, they had had on stream failures, costly of course in terms of downtime, but also hazardous because of the possibility of leaking gasoline liquid and vapors coming into contact with adjacent hot oil pumps and lines.

Today, most lines are permitted to remain untouched, and in some instances, some of the fittings also through three or four consecutive turnarounds. Most ells and tees are usually dismantled, however, for inspection, particularly those with unprotected brazes. This practice, incidentally, is where the value was proved of machining brazed joints smooth.

Some of the first brass liner installations have been in service for better than 10 years and the more recent ones have been in for over three years. In no case has it been necessary to replace the pipe. Pipe containing brass lining is identified by putting a letter "B" on the outside surface with weld metal.

Walter Boon, at that time a zone engineer and at present safety director, pioneered the work at Marcus Hook on the technique. Stephen Korab, welding department supervisor, cooperated with Boon on the development work, as has also more recently James Uhan, chief corrosion engineer at the refinery.

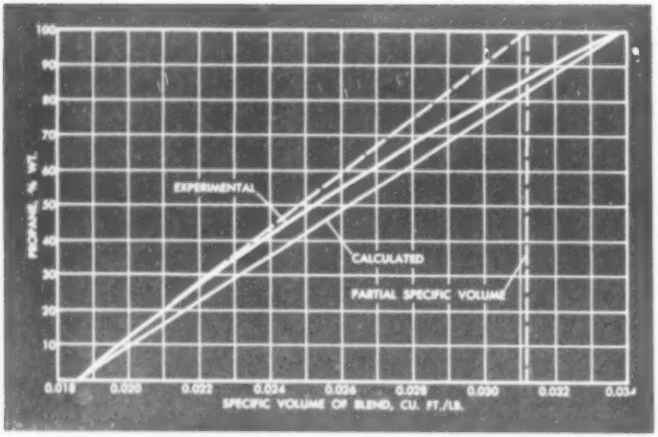


FIG. 1 Specific volume of blends of propane and benzene (temperature, 100 F.)

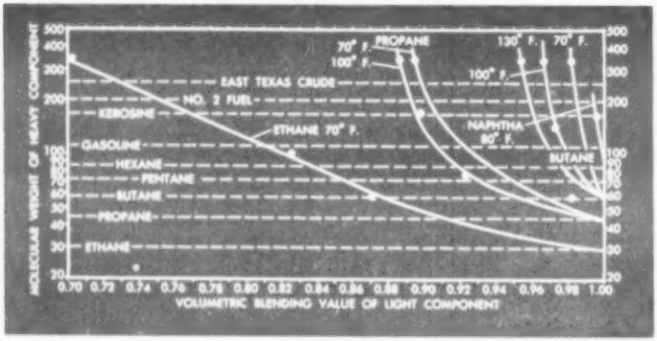


FIG. 2 Volumetric blending values of hydrocarbons

Determining Volume Changes In Hydrocarbon Blending

By E. J. REEVES, Technical Department
Refining Division, Magnolia Petroleum Co., Beaumont, Texas

VOLUMETRIC changes that might occur when blending hydrocarbons are important to both petroleum refineries and natural gasoline plants since the economic values assigned to individual products might be affected. These blends are normally assumed to be "ideal solutions" in which the total volume is equivalent to the sum of the volumes of the components. However, data available in the literature indicate that a slight volumetric contraction or expansion may be encountered.

Several investigators [1,2,3,4,5] report non-ideal solutions at high temperatures and pressures, particularly in the region of the critical point; but information on volume changes is meager for the many industrial operations involving liquid blends or gas-liquid solutions at normal atmospheric temperature and pressure. Thiele and Kay [6] reported a contraction of 0.25% vol. when blending light and heavy petroleum naphthas. Van Der Vet [10] found a decrease in total volume of 0.2% for blends of propane and butane.

Experimental determination of the volume change is difficult and large errors may be involved. The most satisfactory way for evaluating mixtures is through calculation of the partial specific volume of the components of the blend by the graphical methods outlined by Lewis and Randel [9] and Rozeboom. [8] The partial specific volume is determined using the specific volume-weight composition relation. The relation for propane-benzene system is shown in Fig. 1 and may be used to illustrate the method of calculation. Slight curvature of the line between 0% and 100% wt. propane indicates that volumes are not additive and that a contraction takes place. The intercepts at 0% and 100% wt. propane of a tangent to the curve in Fig. 1 are the partial specific volumes of benzene and propane, respectively, at a blend composition corresponding to the point of tangency.

Within the range of 0-15% wt. propane the tangent will pass through or very near the point for specific volume of benzene and it may be assumed that the partial specific volume and the specific volume are the same. The volume change may be attributed, therefore, only to the contraction of propane.

Specific volume-weight composition data were found in the literature for the systems listed in Table 1, and were used to determine partial specific volumes at low pressures and approximately normal atmospheric temperatures. In all of the systems investigated it was found that the volume change, within the range of 0-15% of the lighter component, might be attributed wholly to the contraction of the lighter hydrocarbon. From partial volume data a blending value for each component of the blend may be calculated. Blending value is defined as the ratio of the partial specific volume to the actual specific volume. By this procedure the blending value of the heavy component is 1.00 and the blending value of the lighter component depends on the temperature and the other hydrocarbon in the system. Blending values for the various hydrocarbon systems investigated are shown in Table 1.

Only volumetric contractions were observed for these blends. At other conditions of temperature and pressure the change might be smaller or an expansion might even occur. However, the data shown in Table 1 are for conditions most frequently encountered in industry and should be useful for economic calculations.

Blending values of lighter components as a function of molecular

Table 1—Blending Value of Hydrocarbons in Various Systems

Hydrocarbon System			Blending Value of Light Component	Literature Reference
Light Component	Heavy Component	Temp., F.		
Ethane	Butane	70	0.970	6
Ethane	Gasoline	70	0.929	6
Ethane	Crystal Oil	70	0.700	10
Propane	Butane	60	0.982	14
Propane	Benzene	100	0.923	2
Propane	Kerosine	100	0.897	3
Propane	Crystal Oil	70	0.894	9
Propane	Crystal Oil	100	0.890	3
Butane	Decane	100	0.975	7
Butane	Crystal Oil	70	0.982	11
Butane	Crystal Oil	100	0.967	11
Butane	Crystal Oil	130	0.954	11
Lt. Naph.	Hvy. Naph.	80	0.995	13

weight of the heavy component are shown in Fig. 2. This chart permits estimation of blending values for hydrocarbon systems that might be important but have not yet been evaluated experimentally. Interpolation should be made only for saturated hydrocarbon blends or systems similar to those used in development of the relation. Unsaturated or other compounds might have entirely different volumetric properties. For example, propene and butene (1) show an expansion when mixed.

The method for use of the blending value chart shown in Fig. 2 is outlined in the following problem: What is the blending value of propane in gasoline at 100° F.?

The molecular weight of gasoline is determined from A.P.I. gravity and mean average boiling point. Intersection of the molecular weight line (which in this example is 110) with the experimental line for propane at 100° F. gives the blending value of propane as 0.906, showing an apparent loss of 9.4% of the propane added. This blending value may be used for quantities of propane varying from 0-15% vol.

Conclusions

The investigation revealed that a change in volume takes place when blending saturated hydrocarbons at low pressures and normal atmospheric temperatures. This is contrary to the general belief that "ideal solutions" are obtained for such systems and that volumetric changes occur only at high pressures and temperatures. Within a small range, 0-15% vol. of low molecular weight component, the contraction is a function of the molecular weights of the blend components.

Acknowledgment

The writer would like to express his appreciation to J. W. Newton, W. W. Tuttle, P. L. Smith, and V. A. Kalichevsky for permission to publish this manuscript. This article was originally presented at a meeting of the American Chemical Society in Austin, Texas, Dec. 7, 1951.

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THE FACE IS FAMILIAR, but . . . Originally, names hats at the Shell Chemical plant at Pittsburg, Calif. (Bay area) to encourage more workers to wear them. The by-product of quick recognition made them popular, according to Charles P. Burnett, personnel and industrial relations manager. Demonstrating the headgear (l-r) are: three general mechanic helpers, Claud E. Graham, William (Bud) Caudel, Jack C. Wilson, and first class pipefitter Salvatore (Mack) Macaluso.

BEING HOISTED into position is 157-foot, 200-ton distillation tower once destined for Soviet Russia. Instead it has been installed in General Petroleum's Torrance (Calif.) refinery to make avgas components. Originally built during World War II for a Soviet refinery, tower remained in U. S. with cancellation of lend-lease shipment in 1945.

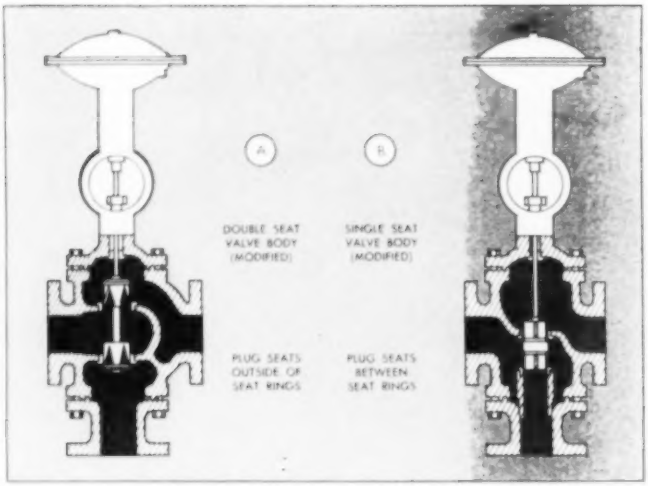


FIG. 1. Two types of three-way control valves: **(A)** made from a double-seat valve body, and **(B)** from a single-seat valve body.

How to Use 3-Way Control Valves

for efficient operation of heat exchangers

By J. A. PELLETTERE and R. L. PATTON, Gulf Oil Corp.

HEAT exchange equipment can be closely controlled for efficient operation by using the so-called three-way control valve. However, designing, selecting, and engineering a valve of this type for such service requires some enlarged concepts and increased knowledge over that normally utilized in conventional two-way control valve selection.

Three-way valves are best known as either diverting valves or mixing valves. When used as a diverter, the three-way valve causes one inlet stream to split between two outlets; in the limiting positions the incoming flow is entirely diverted to one or the other of the two outlet ports. As a mixing valve, the three-way valve has two inlets and one outlet, and is used to mix two fluids in a variable proportion, as for example mixing hot and cold water for a shower bath nozzle.

Hand-operated three-way valves have been used for many years, of course, usually in the form of a three-ported plug valve or cock. This discussion is limited, however, to control valves with conventional types of plugs and seats.

The dual plugs, unlike other double-seated valves, are opposite acting so that as one port closes the other must open. They are usually designed so that orifice areas are equally interchanged; that is, if one port is 25% open, the other is 75% open, and so on. Thus the three-way valve may be said never to obstruct the line of flow since the total orifice area is constant and the valve cannot be "shut off" in the usual sense. Fig. 1 shows the internal construction of two common types available. (A) is made from a double-seated valve body with slight changes, while (B) makes use of a modified single-seated body. Note also the difference in the plugs: in valve (A) the plug seats are outside the rings, while in valve (B) the plug seats are between the rings.

Although it might be possible to manufacture a valve from a double-seated body with the plug seats be-

Meet the Authors

Mr. Patton

Mr. Pellettere

Joseph A. Pellettere was chief instrument engineer for Gulf Oil Corp. before his untimely death in January. Associated with the company since his graduation from Rice Institute in 1922, Mr. Pellettere was well known in the instrumentation field and for many years a member of the chemical engineering faculty of the University of Pittsburgh in addition to his duties with Gulf. He was a member of the Instrument Society of America, American Society of Mechanical Engineers, and the American Petroleum Institute.

Robert L. Patton, like Pellettere a Texan, was graduated from Texas A & M in 1933 and joined Gulf at Port Arthur in 1934, moving up to Pittsburgh in 1938. He was transferred to the instrument department in 1939. Two years ago he moved to Gulf's Cincinnati refinery to supervise the instrument department.

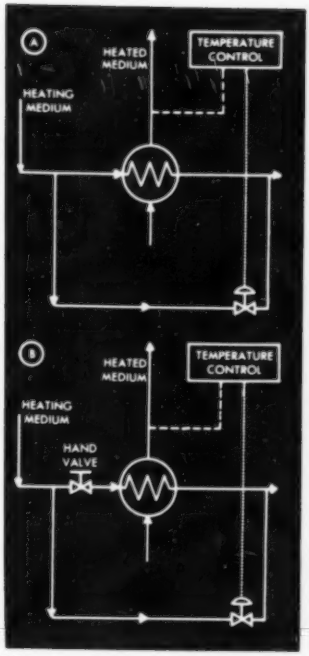


FIG. 2 Early methods of by-pass heat exchanger control

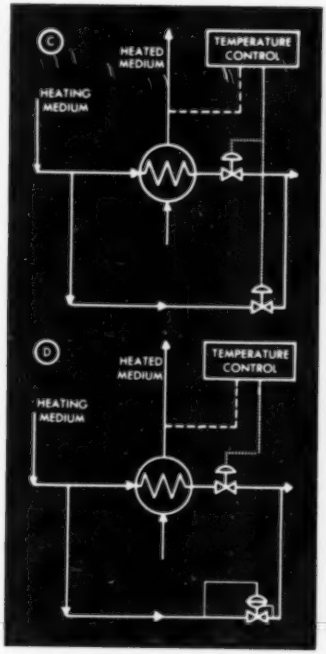


FIG. 3 By-pass control methods using opposite-acting valves or one control valve and one differential pressure valve

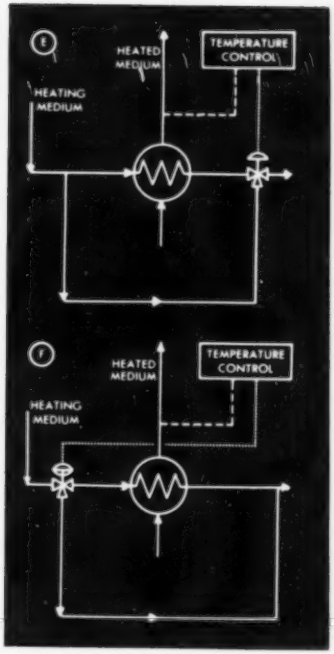


FIG. 4 Two ways to use three-way valves: upstream and downstream of the exchanger

tween the rings, there would be no convenient way of removing the plug and stem for cleaning. As far as operation of the valve is concerned, however, there is no basic difference between this valve and valve (B). Therefore, subsequently we shall refer to a valve with seats between the rings as a "single-seat body", and one with seats outside the rings as a "double-seat body".

A good illustration of a diverting service may be found in the dairy industry in connection with a milk pasteurizer. The outlet or finished milk stream of the pasteurizer passes through a temperature-operated three-way valve. The temperature controller is of the so-called "Watch-Dog" class, designed to divert the pasteurized stream to a special storage tank if for any reason the milk temperature falls below a predetermined point. Thus bacteria-laden milk is not permitted to enter the finished milk storage, placing the entire stock in jeopardy of bacteria contamination.

This type of control is really "on-off" control, and no particular importance is usually attached to the selection of plug or body design for a three-way valve in this kind of service, as long as working pressures and materials of construction meet requirements.

When we encounter "floating control", however, or the case where the three-way valve plug is normally continuously positioned at some intermediate point, selection of body and plug design is frequently vital to satisfactory control. The most common such installation, and one which is typical, is the tubular heater or exchanger where the temperature of the heated fluid outlet is regulated by controlling a by-pass of the heating medium around the heater. Before considering the three-way control valve for this service, a brief summary of early methods leading to the adoption of the three-way valve will help to point up some of the problems involved.

Fig. 2 shows an early method of bypass control, using a conventional two-way control valve in the bypass as in (A). Many such installations are still being used today. As long as the amount of fluid to be bypassed does not exceed roughly 25% of the total, good control may be had. It is readily apparent that zero bypass is obtainable by causing the control valve to close off, and that low rates of bypass are easily controllable; but the maximum amount of bypass is a function of pipe and valve sizes and tube bundle design. Tube bundle and control valve being in parallel, obviously both must absorb the same pressure loss (neglecting piping losses) at any given time, under all conditions of flow.

Assuming total flow constant, the square root law relating flow and pressure drop tells us that when 50% of the stream is bypassed and 50% goes through the exchanger, the net pressure drop must be just one-quarter as much as when all goes through the exchanger. If 75% is to be bypassed, the net must be just one-sixteenth. In other words, the more flow required to go through the control valve, the less pressure drop it must take in so doing, so there is bound to be a limiting flow somewhere. As stated, in practice the limit has been found to be somewhere in the vicinity of 25% bypass for a reasonably sized control valve in a reasonably sized pipe.

With increases in throughput rates and more versatile operations, 25% was frequently not enough. The first solution was to place a hand throttle valve in series with the heater in order to force more through the control valve as in Fig. 2, (B). This works, but it requires manpower to adjust the hand valve to a new position for every load change, thus destroying the idea of remote automatic control.

The next thought was to replace the hand valve with a second control valve. By making its action opposite to that of the first control valve, both could be operated by the same air impulse, Fig. 3, (C). A variation on this used a differential pressure control valve in the bypass and placed the original control valve in series with the heater, Fig. 3, (D). This maintains a constant pressure

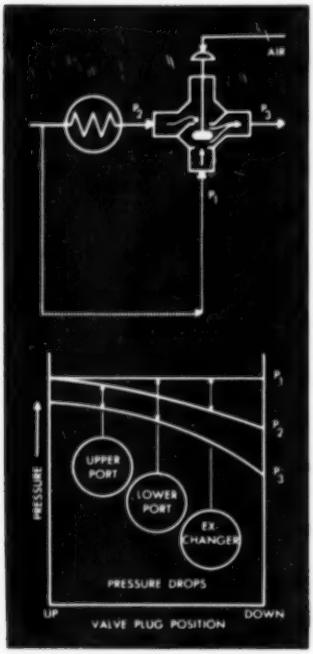


FIG. 5 Pressure drops in three-way valve systems—Arrangement I

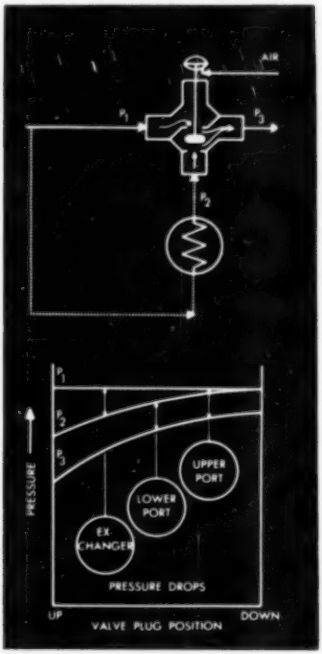


FIG. 6 Pressure drops in three-way valve systems—Arrangement II

drop across the bypass valve while the series valve adds to the exchanger resistance sufficiently to produce the required flow ratio. This has the additional feature of maintaining the net pressure loss across the system at a substantially constant value for all load conditions. The systems shown in Fig. 3 operate automatically, by remote control, and will serve for all load conditions.

But two valves cost more than one and require twice as many maintenance men to repair and service them. A three-way valve is actually able to replace these two valves, with the attendant saving in initial cost and in upkeep. It will probably cost a bit more than one two-way valve, but almost certainly less than two. Fig. 4 shows the same problem solved by a three-way valve in two ways; in (E) the valve is downstream of the exchanger, in (F) it is upstream of the exchanger.

To select intelligently a three-way control valve for such a service and to lay out the construction scheme, we now see that there are some new decisions to make which are not normally encountered in selecting an ordinary control valve:

(1) Should the valve be installed upstream or downstream of the exchanger?

(2) Should the exchanger be in series with the upper port or the lower port of the control valve?

(3) Should the single-seat body or the double-seat body be used?

(4) Should a direct or reverse acting topwork be employed?

Note that items (1) and (2) have to do with equipment and piping layout, whereas (3) and (4) concern the construction of the control valve itself. As shown in the following analysis, the relationship is such that the type of control valve selected is dependent on how it is to be installed. In other words, the decisions should be made generally in the order named.

Figs. 5, 6, 7, and 8 show the four possible combinations of decisions (1) and (2), with the best choice in each case for decisions (3) and (4), together with a pressure-drop analysis for each choice. In Fig. 5 the control valve is downstream of the exchanger, with the exchanger in series with the upper port of the valve. The valve chosen has the single-seat body and direct-acting topwork; that is, controlled air is on top of the diaphragm. If the resistance of the piping is assumed negligible, as it usually will be in a close-coupled system, the pressure drop across the exchanger is $P_2 - P_3$, across valve upper port $P_3 - P_4$, and across valve lower port $P_4 - P_5$, as shown in the pressure diagram, which illustrates how the pressure drops vary as the valve moves through its stroke under load.

The maximum unbalance occurs as the bypass port nears its closed position. Note that in this valve the air pressure on the diaphragm acts in opposition to the direction of this force of unbalance, and that the direction of the unbalance is such that it tends to open the port so that it is not self-regenerating. If we used a double-seat body in this case, regardless of air action, as the lower plug approached its seat it would tend to slam shut. In fact, the upper seat would do the same at the other end of the stroke, and we would have an inherently unstable valve, and one likely to chatter when near either seat.

In Fig. 6 the valve is still downstream of the exchanger, but the exchanger is in series with the lower port. We still use the single-seat body, but the reverse air action is employed for the same reason as before: to oppose maximum unbalance with maximum force. (It is assumed that probably some excess air pressure will be available over that nominally required to stroke the valve.) If a "springless motor" is used on the valve, where full air pressure is available in either direction, then of course "direction of air action" is of no importance.

Fig. 7 shows the control valve installed upstream of the exchanger, with exchanger in series with the upper valve port. The double-seat body is used, since as either plug approaches its seat the force of unbalance tends to keep the port open rather than to slam it shut. And since this unbalanced force is greater when the bypass port is the one approaching closed position, the reverse acting topwork, with air pressure under the diaphragm, is the correct choice.

In Fig. 8 the exchanger is placed in series with the lower port, with the valve again upstream. By reasoning similar to the foregoing, the double-seat body with direct acting topwork is chosen.

It should be pointed out that when pressure drops are relatively large, the importance of choosing the correct valve body can hardly be overemphasized, although if pressure drops are to be low, say of the order of one or two p.s.i., it is entirely possible that either type of body will give satisfactory control. In general, however, as we have seen, the correct procedure is to use a double-seat body upstream of equipment and a single-seat body downstream of equipment; and to choose the air action so that the air pressure tends to close the bypass.

Location of the three-way valve in the system will of course be governed by the circumstances of each individual case. Sometimes the loca-

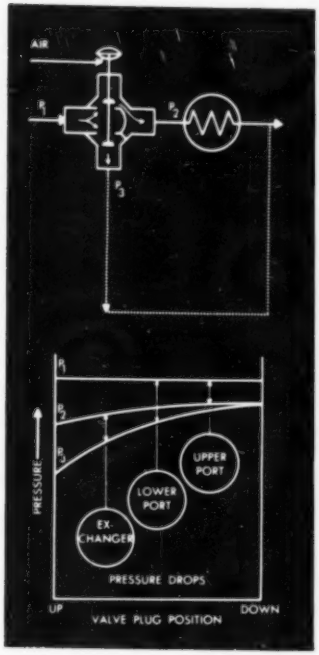


FIG. 7. Pressure drops in three-way valve systems—Arrangement III

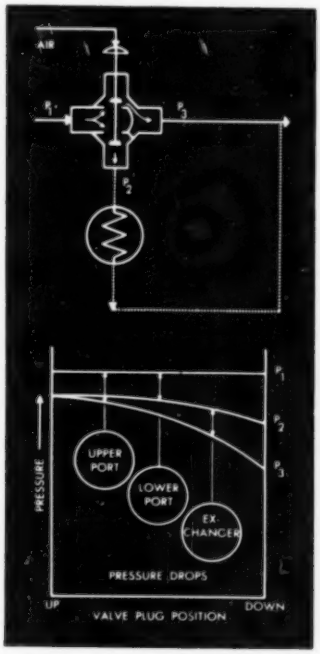


FIG. 8. Pressure drops in three-way valve systems—Arrangement IV

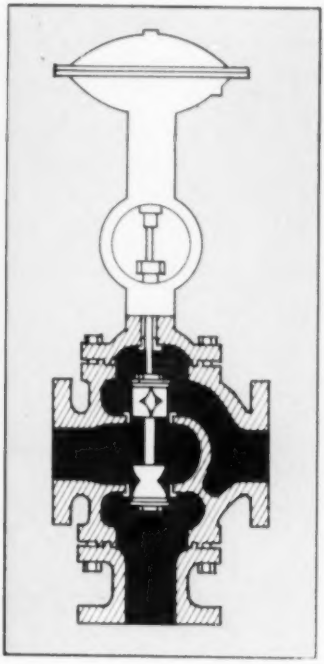


FIG. 9. Three-way control valve with modified diamond ports

tion of other equipment and the piping layout will make it necessary to place the valve upstream of the exchanger, or to place the exchanger in series with the lower valve port, particularly in the case where an existing unit is to be revamped. In such an event, the valve construction should be as shown in Figs. 6, 7, or 8, whichever applies. But if there is a free choice, the arrangement shown in Fig. 5, with a single-seat body and direct-acting topwork offers the following advantages:

(1) The valve stuffing box is under lower temperature conditions. Occasionally, also, a situation will be avoided where at upstream temperature some of the fluid would flash from liquid to vapor in passing through the valve ports, necessitating a larger size valve.

(2) A direct-acting topwork can use all available air supply pressure, up to the maximum stress permissible in the upper diaphragm case, to an advantage, if additional power is ever needed. The direct-acting topwork is simpler in construction and requires no separate stuffing box.

In ordering, or writing specifications for a three-way control valve, it is extremely important to include enough information for the maker to design and produce a valve which will perform as the user expects. Even for a garden-variety, straight-through control valve the importance of adequate information can hardly be overstressed;[1] and in view of the foregoing discussion it is easy to see that new problems arise in the three-way valve.

In addition to the usual information as to temperature, pressure, density, and rate of flow of the fluid entering the valve, materials of construction, type of flanges, body and port sizes, etc., the manufacturer will have to know the conditions of flow through each port of the valve in order to determine the maximum stem load and diaphragm size. Topwork design also requires knowledge of the maximum air pressure to be used. And to verify that the plug size specified will be suitable (or to calculate plug size if this is left to the supplier) he must have correct information as to how the valve is to be installed with reference to other equipment in the line.

Probably the best way to furnish such data is to include a sketch similar to one of those in Figs. 5, 6, 7, and 8, marking on the sketch all known conditions of flow, pressure, temperature, etc. Pressure drop through the exchanger at rated flow is important; and some provision must be made to allow for fouling of the tubes as the exchanger becomes dirty, which will increase the pressure drop.

Many three-way valves are furnished with rectangular ports; that is, orifice area exposed is in direct proportion to stem movement for each port. This insures equal exchange of orifice areas as the stem moves. Some valves, however, are manufactured with V-ports; in order for area exchange to be equal, the points of both V's must be in the same direction. At least one manufacturer uses a special shaped port which could be called a modified diamond, as illustrated in Fig. 9. This design also trades equal orifice areas.

Of the three port designs, the authors feel that the modified diamond port offers some advantages over the others, in the same way that the "logarithmic" or "equal percentage" valve plug is generally superior to a "linear" plug where a conventional control valve is in series with a load.[1] As the plug approaches its seat, the pressure drop is tending to increase to its largest value just when we are trying to choke off the flow to its smallest value. The diamond port, giving the most rapid decrease of area as either plug approaches its seat, helps to make the stem position less critical in this circumstance. The V-port valve does the same at one end of its stroke, but at the other

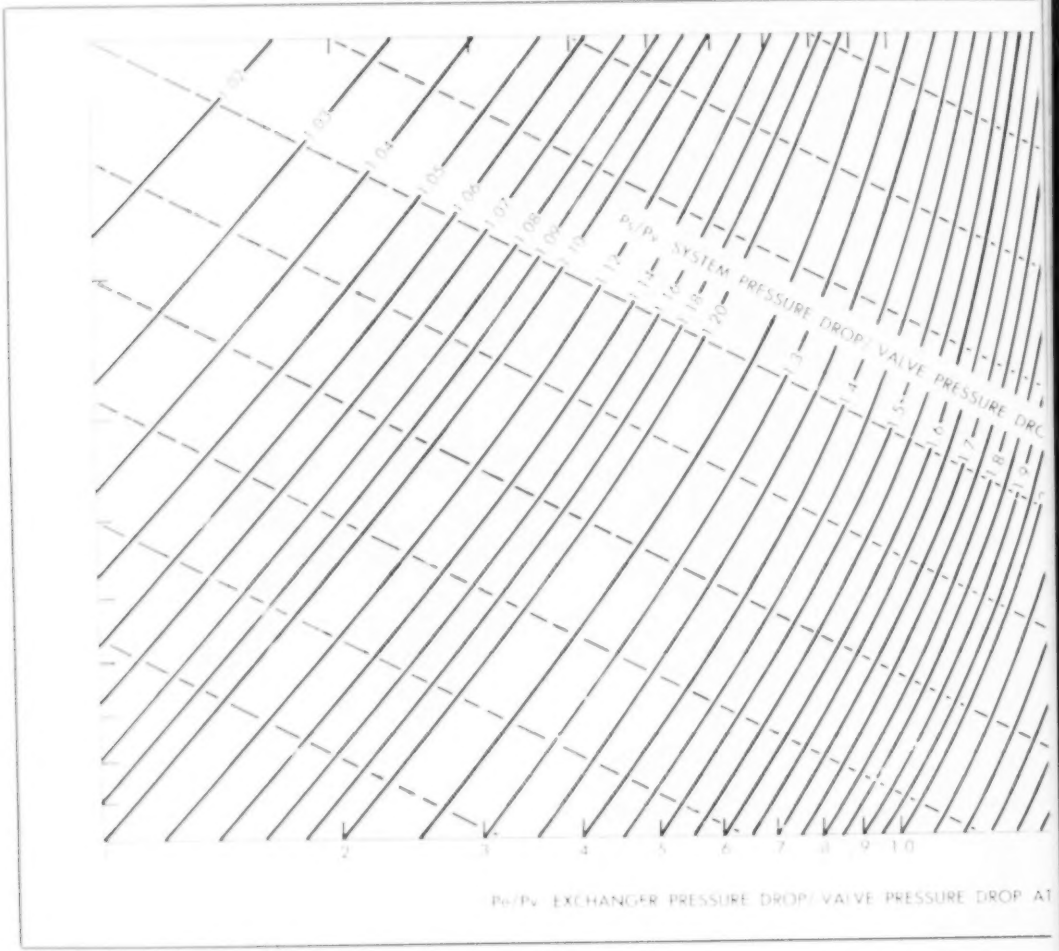


FIG. 10 Pressure drop through exchanger systems using three-way valves (liquid systems only)

ered the broadest part of the V is the last to close off.

It must be remembered that the term "pressure drop through valve" involves a slightly different concept when applied to the three-way valve. At all intermediate plug positions there are two separate pressure drops across the two ports. The basis for determining plug size would be based on maximum flow through either port with minimum available pressure drop through the same port. This would normally be the condition where the bypass port is closed off completely and the total flow passes through exchanger and upper port of the valve.

Frequently it is helpful to have available data correlating pressure drops with flow rates, at varying percentages of bypass, in the early stages of design before the valve manufacturer has been consulted. This sort of information is important in determining pump discharge pressures, pipe sizes, exchanger design, and the like, and in coordinating all these with the control valve selected. The calculations involved in such a study are rather tedious, when intermediate plug positions enter the picture, since a cut-and-try method is necessary to determine the relative port areas for each given set of flow conditions, and to match these port areas with their pressure drops.

The chart shown in Fig. 10 was developed to reduce this drudgery, in laying out a system involving several heaters in series, and is reproduced here in the hope that it may prove useful to others. The chart should not be used without a clear understanding of the assumptions and limitations, as follows:

(1) It is valid only for liquid systems under non-flashing conditions, although it will serve for vapors or gases when pressure drops do not exceed the critical value of one-half upstream absolute pressure.

(2) Both orifices in valve are assumed to be of the same size and to be similar in resistance to flow. Shape of ports is immaterial as long as they are arranged for equal area exchange.

(3) Resistance of the bypass piping is assumed negligible; also the piping between exchanger and valve. Under these assumptions, the pressure drop across the lower seat (bypass port) must always equal the sum of the pressure drops across exchanger and upper seat.

(4) Figures obtained from the

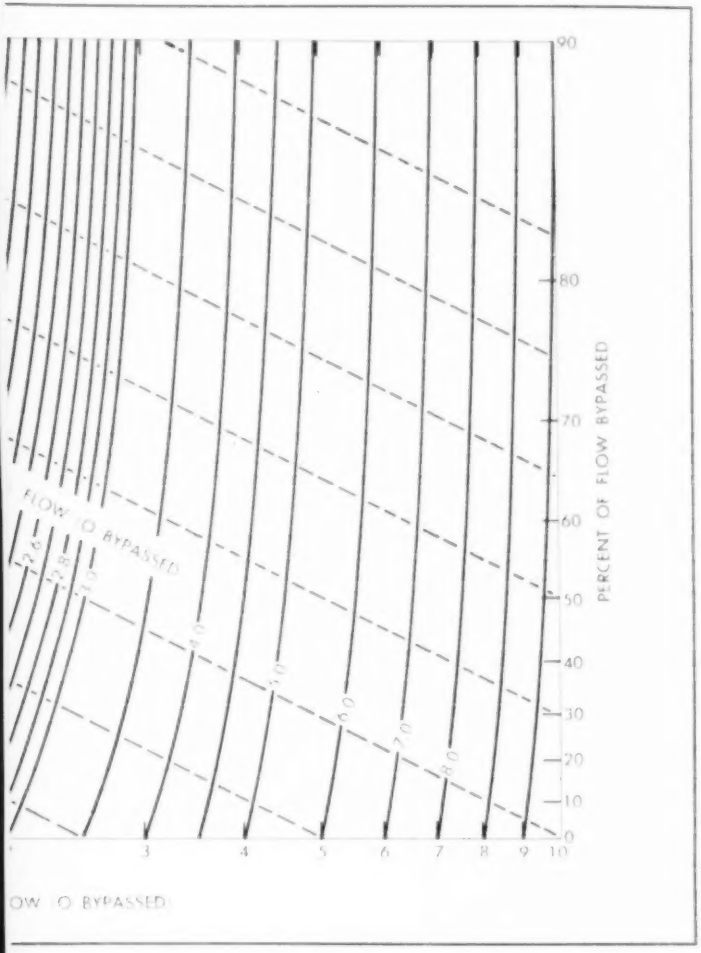
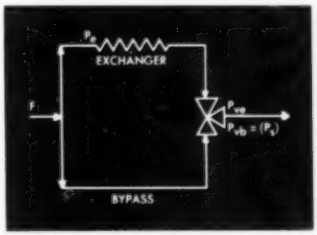


chart apply equally to the case where the valve is installed upstream of the exchanger.

(5) All calculations used in preparing the chart were based on the theory that pressure drop varies as the square of flow rate and that flow rate varies directly with orifice area when pressure drop remains constant. It is quite probable that neither of these relationships is *exactly* true in a control valve, especially as flow rates and pressure drops become fairly large.

With the above limitations, the chart will provide information on overall pressure drops under varying conditions of flow rates and bypass rates. Having determined a total pressure drop (which is equal to the drop across the bypass port) it is also possible to determine the drop across the other port by calculating exchanger drop and subtracting from the total.

To use the chart, it is necessary to know the pressure drop through the exchanger at any flow, P_e and the pressure drop through the three-way valve with one port closed at maximum flow F, P_v, based on the following schematic diagram:



Compute P_v/P_e. At the intersection of P_v/P_e and the % by-passed on the chart, draw a straight line, parallel to the diagonal dotted lines. Then along this straight line, the intersections with the curved lines representing P_v/P_e will give the values of this ratio for any % by-passed. Multiplying P_v/P_e by the P_e originally used gives P_v, the pressure drop across the system. Note that the same straight line drawn will serve for the same system for all conditions. But for any change in the total flow F, a new P_e must be obtained. Checking the following examples will make one an expert in using the chart:

An exchanger is designed for a pressure drop of 10 psi. at a flow of 100,000 lb. hr. Quantity of flow F = 125,000 lb. hr. Valve pressure drop at flow of 125,000 lb. hr. = 12.5 psi. (from valve manufacturer's data). P_v/P_e = 10/12.5 = 0.8. Per cent by-passed = 25,000/125,000 × 100 = 20%.

Entering the chart at P_v/P_e = 0.8 and 20% by-passed, follow the dotted line going through that intersection. At 20% by-passed: P_v/P_e = 1.7; P_v = 1.7 × 12.5 = 21.3 psi. At 40% by-passed: P_v/P_e = 1.3; P_v = 1.3 × 12.5 = 16.3 psi. At 0% by-passed: P_v/P_e = 2.25; P_v = 2.25 × 12.5 = 28.1 psi.

If total flow F is now increased to 175,000 lb. hr., determine the new P_e at new flow (from manufacturer's data) = 24.5 psi. At 0% by-passed: P_v/P_e = 2.25; P_v = 2.25 × 24.5 = 55.1 psi. At 20% by-passed: P_v/P_e = 1.7; P_v = 1.7 × 24.5 = 41.7 psi. At 40% by-passed: P_v/P_e = 1.3; P_v = 1.3 × 24.5 = 31.9 psi. At 60% by-passed: P_v/P_e = 1.09; P_v = 1.09 × 24.5 = 26.7 psi.

It is absolutely necessary, of course, that the valve is not installed backwards in the line. This is not too serious for an ordinary valve, as it will still operate. But a three-way valve positively will not function if installed backwards. It is extremely discouraging to remove, reverse, and replace a ten or twelve-inch diaphragm valve, to say nothing of the delay in starting up a unit if the mistake is not caught in time.

A satisfactory system of marking should be agreed upon with the manufacturer. Possibly the most foolproof method is to stencil on the appropriate flanges the words "exchanger", "by-pass," and "outlet," or your own equivalents. And it would be well to arrange for someone who knows how a three-way valve operates to be on hand to inspect before the line is "buttoned up," as a double check.

References

(1) "How to Get What You Need When You Order a Valve," by D. P. Thornton, Jr., Petroleum Processing, August, 1951, pp. 844-7.

(2) "The Control Valve—Its Application," by J. A. Pellettere, Instrument Society of America, 4th national conference, St. Louis, Mo., Sept., 1949; and *Petroleum Engineer*, November, 1949.

Is 1000-Mile Oil Change a Must?

Very probably, but acid vapor temperature test still needs correlating proof, say readers

"IS 1000-mile oil change a must—or is it?" And why? This question, already well-known as a controversial topic, has raised anew some pointed comments as a result of the article in the January PETROLEUM PROCESSING pp. 69-75, "Tests on Lube Stability vs. Corrosion Show that 1000 Mile Oil Change Is a Must," by W. F. Weiland.

In general, readers who commented have agreed with Prof. Weiland that the critical point in motor oil breakdown under actual engine use is about 1000 miles. Where they disagreed was in the "proof of the pudding." A summary of the main points of disagreement in letters received since publication of the article shows:

1. Not enough detailed data was given on performance and service or comparison of test results with actual engine conditions.

2. Oxidation of the oil is no longer a problem with today's anti-oxidation additives.

3. Other factors were not considered, such as insolubles present, breakdown of additives, and contamination by dilution, dirt, moisture, sludge, etc.

4. There are not enough details on the acid vapor temperature test procedure. Is it really practical for use by fleet operators or service station personnel?

5. Just how reliable is the copper test?

6. Other investigators have shown different results regarding the effect of aluminum on lubricating oils.

In partial answer to some of the questions raised, Prof. Weiland has furnished PETROLEUM PROCESSING with the following supplemental report:

A rather extensive investigation was completed recently on 22 lubricating oils. These oils were tested for corrosion rate as determined by metal in solution or colloidal suspension in the oil after specified oxidation periods. These corrosion rates are a function of the acid vapor temperature characteristics. Likewise the gum-forming properties are related to another function of the AVT characteristics. The oils are divided into three broad corrosion rate groups and three gum rate groups as follows:

Corrosion Groups

A. Low corrosion rate	4 units
B. Medium corrosion rate	8 units
C. High corrosion rate	20 units

Gum Groups

1. Low gum rate	5 units
2. Medium gum rate	7 units
3. High gum rate	9 units

The best oil of the entire group was assigned a corrosion rate of one (1). The poorest turned up with a corrosion rate of 27. If conditions are such that the oil of the lowest gum rate begins to form gums in 100 hrs., the poorest will begin to form gums in 8 hrs.

The significance of the above tabular listing is emphasized by the following examples, each using an oil from Group C (high corrosion rate). The oldest vehicle in the list is a 1949 model.

Vehicle Type	Major Overhaul
Passenger car, cuts driving	At 20,000 miles
Passenger car, mostly open roads	At 25,000 miles
Passenger car, cuts & open roads	At 15,000 miles
Farm tractor, 150-hr. oil changes	After 1½ seasons

In each instance the cars had normal care, with oil changes at 1000 to 1500 miles.

The "1000 Mile Oil Change" is the normal. Under poor driving conditions, with poor oil, and with the engine in poor condition; oil changes must be more frequent. In the next table, (see Table 1) oil samples were taken at approximately 100-mile intervals. These samples were tested for AVT and for concentration of metal in the oil. These cars all used the same oil, the same gasoline, and were serviced by the same mechanic. Driving conditions were mostly rather poor.

The normal oil change practice for these cars is 1000 to 1500 miles. In every instance, corrosion incipience by test for metal in the oil was noted when the AVT was in the vicinity of 215° F. Metal in the oil became excessive in the vicinity of AVT 150° F., and the concentration rose hyperbolically thereafter.

To avoid excessive engine wear, the oil should be changed prior to the rapid increase in metal concentration which occurred in Cars 20, 22, 23, and 25 at 350, 300, 1100, and 900 miles respectively.

A more complete study, with additional overhaul data on some of the oils in the low corrosion group, as well as some details on test procedures, are to be made available to PETROLEUM PROCESSING by the author at a later date.

One error in an illustration in the January article was called to our attention: Fig. 3, showing relation of AVT to engine mileage, should have included a series of four triangular symbols in addition to the black dots. A corrected Fig. 3 is reproduced with this present article. Following is the textual reference to Fig. 3 from the January article:

Controlled studies are necessary on the condition of lubricating oil in terms of miles of operation. Results of one study on a number of vehicles is shown in Fig. 3. The black dots show results of tests on a milk pick-up truck which travels approximately 100 miles day over the same route. A 25-ml. sample of oil was taken each day from the crankcase immediately after the truck returned from its trip and before the oil had settled. In this manner a fairly representative sample was obtained. The triangles are the results of a similar test several months later when the accumulated mileage was nearly 30,000. The oil was changed regularly in this engine at about 1600 miles. The truck was always operated by the same driver, and the same oil was used through-

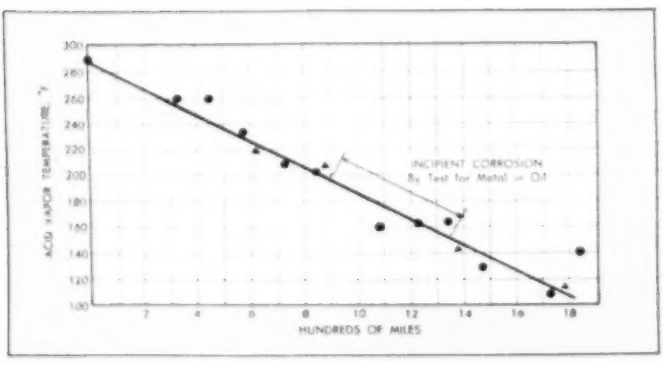


FIG. 3 (corrected). Relation of AVT to engine mileage

out. Most significant is the close correlation of the curve for the new engine and for the same engine after 30,000 miles.

Highlights from six of the commenting letters are presented in greater detail below, along with Prof. Weiland's replies. Four letters were from oil company men, one from a metal manufacturer, and one from a college professor.

Five questions were posed in a letter from the general manager of direct marketing of one oil company:

"1. The acid vapor temperature procedure as described is not one which is in general use by the industry, and our laboratories have had no particular experience with it. We have had no experience in co-ordinating the results obtained by this method with actual field service experience, and therefore cannot state whether or not it might be of importance in evaluating the condition of used motor oil samples. The article does not furnish much information to show comparisons between test procedure results and actual engine condition on any large volume of equipment.

"2. The article appears to be primarily concerned with the effect of oxidized oils on bearing corrosion. The industry is not particularly concerned with this problem any longer. Only a few current passenger cars are fitted with alloy bearings which are subject to corrosion from petroleum acids caused by oxidation of the oil. The better premium type motor oils now generally available throughout the country are adequately fortified with proper anti-oxidation additives to guard against corrosion of alloy bearings . . .

"3. It should also be understood that there are other important factors of motor oil deterioration and contamination such as presence of dilution, dirt, moisture, sludge, etc., which must be considered in evaluating used oil samples and which are not covered by the proposed procedures.

"4. The article suggests the consideration of the AVT test as feasible to check condition of used motor oils in the shops of fleet operators, or at retail service stations, to determine whether or not the oil should be changed. From our interpretation of the data presented, we would not necessarily agree that the proposed procedure would represent an infallible criterion to follow. We especially do not believe that equipment of this kind is justified for conducting such tests at retail stations, because operators at these stations are not qualified technically to make and interpret determination of this nature.

"5. In any event, we note that the article apparently concludes the critical point in the 'breakdown' of average motor oils in actual service is at approximately 1000 miles of operation. In general we agree that such mileage represents a good average safe interval . . ."

Prof. Weiland's reply:

"1. The article was prepared on the basis of representative samples from a large number of tests over a number of years, and therefore apparently does not reveal in detail any extensive correlation between laboratory and service tests. This does not mean that such correlations are non-existent. In fact, through recent developments of procedure I was able to predict the near approach of overhaul periods on a fleet of cars all using the same gasoline and the same oil.

"It may also be of interest to note that within the last 15 months I have accumulated six cases of engine overhauls at 16,000 to 25,000 miles. In each case, these engines used an oil which I have classed as highly corrosive in accordance with my procedure. Such correlations are not to be taken lightly.

"2. Unfortunately we have been subdued to quiescence by the addition of anti-oxidation inhibitors to guard against corrosion. I have just recently completed an extensive investigation of the characteristics of some 22 oils, mostly nationally known brands. To the least corrosive of this group I assigned a corrosion rate of one (1). The worst of the group comes up with a corrosion rate of 27. The oil referred to in the previous paragraph shows a corrosion rate of 18. One half of this group shows a corrosion rate of 10 or above, and only four have a rate of 4 or less. In the light of this information, we most certainly have been lulling ourselves into a state of false security.

"3. The other important factors of motor oil deterioration and contamination such as dilution, dirt, moisture, sludge, etc., are very definitely considered in my procedure, especially as it is applied to oils which have seen some service. The effect of the first three is reflected directly in the AVT and may make it necessary to change the oil at periods as low as 300 miles. The incipience of sludge formation is predictable by new developments in my procedure.

"4. Arguments in this paragraph arise from unfamiliarity with the procedure for making the AVT test.

"5. Regardless of arguments either way, we both come up with the same answer, namely 1000-mile oil changes."

The manager of the automotive division lubricating department, of another oil company brings up the problem of correlating metal strip tests with actual performance data:

". . . My attention was first called to Prof. Weiland's theories on oil deterioration by an article in the August, 1950, *Scientific Monthly*, in which he advances some of the theories contained in the present article. In answer to my request, he was good enough to outline details of the test procedure for me a short while later.

". . . the present article covers a very controversial subject. It might be very difficult to substantiate the main thesis which I interpret to be . . . as a result of oil deterioration, most lubricants in the engine crankcase become sufficiently corrosive at the end of 1000 to 1500 miles to make it desirable to change the oil.

"We quite agree that there are corrosive constituents which build up over a period of time from various sources in the lubricating oil and, furthermore, that this is one of the reasons why oil should be changed at or near the 1000-mile mark. We have not had very good luck in correlating engine oil performance with metal strips placed in oil at various temperatures. One reason is that many of the inhibitors which are very useful in preventing copper lead bearing corrosion in the engine cause the oil to have a definite darkening effect upon copper in beaker tests, even at quite low temperatures."

Prof. Weiland's reply:

". . . Actually this subject is not as controversial as some would lead themselves to believe.

"The discoloration of copper by many inhibitors is apt to be extremely confusing and only very general conclusions can be drawn from such tests. I have a number of very definite instances in which the dark discoloration or deposit had no apparent retarding effect on corrosion and others in which the discoloration seemed to be slightly beneficial. Then there are other instances of very little discoloration in which corrosion is violent.

"It is such discrepancies that led to the development of my procedures. The basic conclusion is given in the article, namely, that corrosion incipience can be expected when the AVT has dropped to 215° F.

"Since the paper was written, some 22 brands of new oils and many samples from operating vehicles have been investigated. The conclusions remain the same: corrosion begins at an AVT of 215° F. and is apt to become serious at an AVT of 150 to 170° F."

Failure to evaluate other factors is the concern of the manager of the lubricants department of another oil company:

"While we are in accord with the

general recommendation for a 1000-mile motor oil change, we do not believe that the method advanced by Mr. Weiland is of sufficient scope to justify its use as a sound basis for determination of the drain interval. In our opinion, it fails to evaluate the factors such as pentane insolubles, benzene insolubles, dilution, and fortification depletion accepted as being most significant in judging the condition of a used motor oil.

Further in this connection we mention that virtually all used oil tests are useful chiefly insofar as they have been correlated with observed engine conditions and or service life in field and performance tests."

Prof. Weiland's reply:

"It is most interesting to note that Mr. . . . . agrees with the general recommendation for a 1000-mile oil change, but in the same sentence expresses a 'belief' but no proof that my method is fallacious.

"Dilution, insolubles, fortification depletion which he considers as significant in judging the condition of used motor oil all are factors which are reflected as a function of the acid vapor temperature.

"In answer to the last paragraph it may be of interest to know that it has been possible to determine service conditions and the approach of overhaul periods by a study of the behavior of the AVT."

The assistant vice president for marketing of still another oil firm questions the lack of correlation between laboratory tests and field results:

"Prof. Weiland has done a vast amount of work, but the important point to me is the fact that correlation with service is significantly absent. I believe that to make Prof. Weiland's article more satisfactory, and, therefore, better acceptable by both the automotive and the petroleum industries, reduction of his theories to practice through correlation with service would be a tremendous contribution."

Prof. Weiland's reply:

"To reduce the length of my article, it was prepared from representative data and therefore apparently does not reveal in detail any large number of laboratory test and service correlations. This does not mean that such correlations are non-existent.

"Since the article was written, many more examples have accumulated. In fact, only recently by my procedure I was able to predict the near approach of overhaul periods on a fleet of cars, all of which used the same gasoline and the same oil. In addition, the oil-change periods which I recommended for this group of cars varied from 300 to about 1200 miles, based principally on a function of the AVT and on metals in the oil samples.

"Now why should oil-change periods vary over such a wide range? After the recommendations were prepared, a conference with the mangement brought out such factors as type of service, kind of driver, nature of overhauls, and conditions of the engine correlations which to me were no less than amazing.

"Results of tests on assorted vehicles and assorted oils have always come up with same answers: 1) corrosion incipience when the AVT drops to 215° F., 2) corrosion is severe when AVT drops to a certain lower value; 3) an indication of poor driving conditions and the approach of an overhaul period is a function of the AVT."

The "eye-catching" headline on the January article was critized as not justified, by a professor of mechanical engineering in an eastern college:

"The article . . . contains some interesting data which unfortunately do not justify the eye-catching title, nor the statement in the first paragraph that this fact was revealed by road tests.

"The chain of reasoning appears to be as follows:

"1 Oil when oxidized gives acids,

"2 These acids are corrosive to copper,

"3 Oil in service develops acidity,

"4 Normal engine wear is actually corrosion wear,

"5 Oxidized oil causes corrosion of engine parts and thus accounts for the normal wear of engines.

"Points 1, 2, and 3 are satisfactorily substantiated by the data. As we follow the chain of reasoning further, however, the statements are no longer supported by data; no evidence is given, or reference cited, to the effect that normal engine wear is actually corrosion (points 4 and 5) and, particularly for the sweeping claim that the 1000-mile oil change is the answer to the problem.

"Further evidence of the weakness of the argument is given by the comparison between various oils: by the 300° test, oil No. 25 is very good (no corrosion for 6 hrs.) and No. 26 is very bad (begins to corrode immediately); if the test, however, is run at 220°, oil No. 25 gives maximum corrosion and No. 26 is fourth down the list. This illustrates strikingly the well-known danger of attempting to predict service performance on the basis of a laboratory test.

"My own limited experience fails to substantiate the claims of the article. I have kept my last two Chevrolet cars (average family service) five and four years, changing oil once a year (8-10,000 miles) without engine breakdown of any kind, replacement of parts (other than spark plugs), and without abnormal loss of performance or economy.

"I conclude therefore that the article has made an interesting contribution to the oxidation of lubricating oil and its relation to the corrosion of copper, but that the title under which it was published will be justified only when it contains comparable performance data under actual road conditions *with* and *without* change of oil every 1000 miles."

Prof. Weiland's reply:

"It is unfortunate that has missed my basic thesis, namely: oils when oxidized develop volatile organic acids. There is no indication anywhere in the article that acidity is developed in the oil. I am also rather surprised that the significance of copper in oil tests is not generally understood.

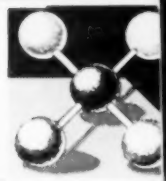
"The third and fifth paragraphs of the article, and also Fig. 3 and Tables 1, 4, and 5 should answer the other objections." (*Editor's note*: the points brought out in Prof. Weiland's article are 1) that engine wear can no longer be assigned to abrasion but rather to corrosion acid vapors in the oil, and occurs at maximum rates in regions of maximum film pressure; and 2) that pitting which develops in heavily-loaded bearings also begins in regions of maximum film pressure; and when it becomes severe, it leads to complete failure by corrosion, metal-to-metal contact, abrasion heating or a number of other causes.)

"I am also wondering why the cars were traded in with only 40-50,000 miles service. It would have been interesting to check the oil and filter cartridges for metal (not copper) at the end of the long drain periods. Then there is the question of how much oil was added during the long between-drain periods and how much make-up oil when filter cartridges were changed."

Table 1—Corrosion Incipience by Metal in Oil

Car No.	Metal concentration at miles indicated			Accum. Mileage	Condition of engine
	Medium	High	Excessive		
20	200	500	500	40,000	Poor—uses oil
22	200	500	800	10,200*	Poor—4 qts. between changes
23	600	1200	1200	20,000	Good—uses no oil
25	500	1000	1100	50,000	Poor—2 qts. between changes

* Since overhaul.



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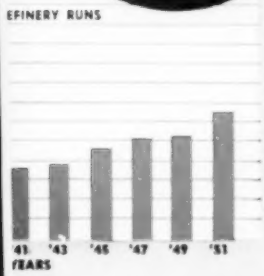

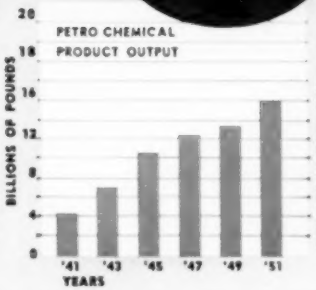

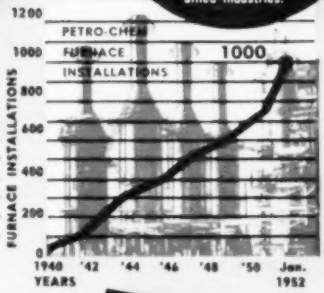

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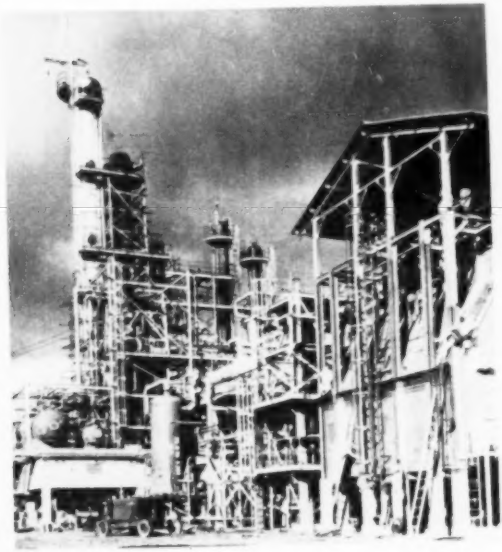


ONE OF THE NEWEST petrochemical plants is that of Texas Eastman at Longview, Texas. In the equipment shown here, built by Lummus Co., propane is cracked in furnaces at right, and resulting propylene and ethylene recovered in columns in background.

Photo courtesy Tennessee Eastman Co.

A New Venture in Petrochemicals

LET'S take a good, long look at this petrochemical business everyone's talking about.

Here is an industry which authorities predict will expand at least four-fold in the next ten years. They estimate it will be producing 64,000,000,000 lbs. annually by 1962. That's a fairly hefty growth from the estimated 1952 total of 17,000,000,000 lbs. By 1962, petrochemicals will amount to about 50% of the nation's entire chemical output, and still will require only 1% of the petroleum and natural gas production at that time.

- Where are all these petrochemical plants?
- Who's running them and what are they making?
- Just what is a petrochemical?
- Is the petrochemical industry like the petroleum industry?
- Or is it like the chemical industry?
- How did it start? Where is it going?
- How does it operate? What are its problems?

When editors of PETROLEUM PROCESSING had combed the country for answers to these questions, they sat down and kicked those answers around a bit, one point soon became obvious as the proverbial proboscis.

The petrochemical industry is crying for a good job of editorial coverage.

We decided that job could be done only by a magazine used to the kind of thinking that goes along with the petroleum industry itself: imaginative, alert, resourceful, aggressive, expansive.

We also decided that a petroleum magazine should be able to do a better job of covering petrochemicals for several reasons. Both the refining and petrochemicals industries use hydrocarbon raw materials, and as a result many of their design, process, equipment, maintenance and safety problems are similar. In addition, many oil companies are in the petrochemical business, either directly, through subsidiaries, or in joint ventures with old-line chemical companies.

As a natural consequence of all our thinking and deciding, we are starting in this current issue of PETROLEUM PROCESSING a special "Petrochemical Processing Section."

In this section we plan to cover not only the technical aspects of petrochemicals, but also the economic phases of the subject. We'll attempt to answer not only the questions outlined above, but also the new ones that pop up.

You'll find this section in this same relative position each issue: immediately following the refining feature articles. It doesn't otherwise change the character of the PETROLEUM PROCESSING to which our usual readers are accustomed. The regular departments will remain unchanged, except for more emphasis on petrochemicals. Nothing has been removed from the magazine to make room for the new section; extra pages have been added to provide the needed space.

We think our new "petrochemical" readers will find much material in this section that will help them do a better job. In addition, much of the usual "refining" material should be of help to them. Our regular "petroleum" readers will also want to keep an eye on this section for ideas they can apply to their own operations and for tips on new fields to conquer.

Your reaction to this new "Petrochemical Processing Section" and your ideas on what you'd like in it will be much appreciated. In the final analysis, you are the one who determines the success or failure of such a venture as we are now undertaking.

—THE EDITORS

What Is a Petrochemical?

pet'ro·chem'i·cal, n. A chemical compound or element recovered from petroleum or natural gas or derived in whole or part from petroleum or natural gas hydrocarbons and intended for chemical markets.

By WILLIAM F. BLAND
Engineering Editor

FOR what it's worth, PETROLEUM PROCESSING submits the above as its definition of what a petrochemical is.

We fully expect that 99% of our readers won't agree with us—at least in some minor respect. But before we could undertake this venture of publishing a special "Petrochemical Processing" section we had to define our subject.

We think our definition is appropriate and sufficiently inclusive, and that it represents the consensus among those persons connected with the subject. It's what we call a "source" definition. It doesn't define a petrochemical by what it looks like or how it's made or what its chemical properties are, but rather by where it comes from.

Here's why we like our definition, bit by bit:

1. *A chemical compound* . . . removes from the petrochemical classification the usually-accepted petroleum products. Gasoline, kerosine, diesel fuel, lube oils, waxes, asphalts and the like are not chemical compounds but rather heterogeneous mixtures of chemical compounds.

2. *. . . or chemical* . . . permits the inclusion of such chemicals as sulfur.

3. *. . . recovered from petroleum or natural gas* . . . permits the inclusion of those chemicals already naturally present in the source material and obtained merely by physical separation processes.

4. *. . . or derived in whole or part from* . . . permits the inclusion of those chemicals made by chemical reactions, including not only the synthesizing or "building up" processes but also the reforming and cracking ones.

5. *. . . petroleum or natural gas hydrocarbons* . . . is obvious, although someone may question why petroleum isn't sufficient to encompass both oil and gas. A recent court decision in Canada is understood to have held that petroleum does include both, but to many persons petroleum is still restricted to liquid oil.

6. *. . . and intended for chemical markets.* Eliminates such materials as butane or alkylate intended for use as fuel or blending agents.

What Others Say

Before we arrived at our definition we wrote nearly a hundred individuals in the industry, asking their opinions. The many replies we received indicated at least interest if not unanimity. We also talked to several dozen persons on the subject.

One of the most comprehensive replies came from Eugene Ayres, technical assistant to the executive vice president of Gulf Research & Development Co. He defines a petrochemical as "any substance derived from crude petroleum (including natural gas) which is intended for chemical markets or for the manufacture of substances for chemical markets."

He then goes on to say that "Such a definition would include the portion of ammonia derived from natural gas or of sulfuric acid derived from petroleum. It would include all ethylene however made from petroleum, unless the ethylene was used to produce synthetic lubricants. It would include styrene, but would exclude isooctane. It would include the portion of butylene going into synthetic rubber, but would exclude butene polymerized to gasoline.

"Such a definition may be considered faulty because there may be differences of opinion with regard to the scope of 'chemical markets.' However, I believe this is a minor fault.

"The above definition would exclude synthetic rubber. This I believe is a good thing because in any survey of petrochemicals the inclusion of synthetic rubber would mean that styrene and butadiene would be counted twice. It is also proper to exclude plastics and synthetic fibers.

"If a chemical or chemical intermediate is made not only from petroleum but also from coal or other raw material, the term 'petrochemical' would apply only to the part of the production derived from petroleum."

William T. Gunn, director of the API Division of Refining, defines a petrochemical as "A compound created from material derived wholly or in part from crude petroleum or natural gas."

T. W. Legatski, acting director of research with Phillips Petroleum Co., defines it as including "all materials which are isolated from petroleum or natural gas for other than fuel purposes and all chemicals which are based in whole or in part on petroleum or natural gas as raw materials."

L. M. Roberts of Shell Chemical Co. recently stated in a paper presented before the Commercial Chemical Development Assn. that "we should say that petrochemicals are the direct derivatives by chemical reactions, of products of oil refining or natural gas."

The Office of Price Stabilization has two definitions. Supplementary Regulation 12 to Ceiling Price Regulation 22 defines petrochemicals as "synthetic organic chemicals containing one or more carbon atoms using fractions of crude petroleum, including hydrocarbon components of natural gas, as raw materials."

In OPS Survey Form S-12, petrochemicals are defined as follows: "Synthetic organic chemicals including hydrocarbons and derivatives containing oxygen, nitrogen, sulfur and the halogens synthesized from fractions of crude petroleum or natural gas hydrocarbon components."

Commenting on the former definition, one petrochemical man (who requested anonymity "because we've enough headaches with bureaucracies to allow any time for debating definitions with them") says it is not good for the following reasons:

"1. The words 'containing one or more carbon atoms' are entirely unnecessary because they are redundant. According to the accepted meaning of an organic chemical, every such chemical contains one or more carbon atoms.

"2. The limitation of the definition to 'organic chemicals' is unwarranted.

for the reason that when a non-organic chemical such as vanadium oxide is derived from petroleum, it is certainly a petrochemical.

"3—The word 'synthetic' is unrealistic for the reason that when so-called naphthenic acids are derived from petroleum, they are certainly petrochemicals although they have not been synthesized."

What Others Are Doing

The nomenclature groups of at least three organizations are studying the subject, and have probably had as much trouble achieving any agreement among themselves as we've had in getting a consensus.

Known to be working on a definition of the word are the Glossary Subcommittee of the API Refining division's Committee on Petroleum Products, the Coordinating Division on Nomenclature of ASTM's Committee D-2, and the Nomenclature Committee of the Division of Petroleum Chemistry of ACS.

Stewart S. Kurtz, Jr., manager of the Research Laboratories for Sun Oil Co. and chairman of the last two groups named is currently conducting a survey. On Jan. 25, following receipt of an inquiry from us as to his own definition, he sent a ballot to the members of the ASTM and ACS groups, asking them to vote approval or disapproval on two suggested definitions:

1. Petrochemical: an industrial term used to include broadly any chemical for which the raw materials are derived in whole or in part from petroleum; occasionally used to cover any chemical manufactured by a chemical subsidiary of a petroleum refining company. The term is without technical or scientific significance.

2. Petrochemicals: synthetic organic chemicals containing one or more carbon atoms using fractions of crude petroleum, including hydrocarbon components of natural gas for raw materials. (This is the OPS definition.)

The results of the balloting hadn't yet been made available at the time this article was being prepared, but Mr. Kurtz expressed to us his opinion that the word petrochemical should be defined in general as a non-technical term, without scientific meaning, which has grown up through usage, has a wide variety of meanings, and cannot be defined sharply.

"There Ain't No Such Word!"

Despite the fact that petrochemical is a commonly accepted word in web usage today, there are still those who detest it and think it should be abolished from the English language.

One of the most outspoken is K. G. Mackenzie of The Texas Co., who says "I see no way in which you can define 'petrochemical' and 'petrochemistry', and therefore I recommend that the matter be dropped." Mr. Mackenzie's thinking seems to be based primarily on the point that the same chemicals can be made in some cases from other sources than petroleum. As examples he points out that butadiene can be made from molasses, sugar and grain, as well as from petroleum.

Most objections, however, are based on the contention that the term is a misnomer and ambiguous because the combining form *petro-* (from the Greek *petra or petros*) means *rock or stone*.

Our viewpoint here—and we believe most of our readers will agree with us—is that the word has been so widely established through popular usage that any controversy on its propriety and any attempt to change it are ridiculous.

We've corresponded with the two major dictionary publishers in the country, G. & C. Merriam Co., and Funk & Wagnalls Co. Both agree on the unfortunate origin of the word, but an editor with one of them predicts that "here, as elsewhere, usage will have its way." An editor with the other points out that "widespread usage among chemists, petroleum engineers, and others seems to sanction the meaning *petroleum* for the *petro-*," and further reminds us "that in the field of pharmacy the combining form *petro-* as short for *petroleum* has been in use for a number of years and means *containing petroleum and*."

Even some of the strongest opponents of the term are softening in their attitude. B. H. Weil, who has written many articles on the subject of chemicals made from petroleum and is now supervisor of the information division of the Ethyl Corp. in Detroit, has frequently taken exception to the use of the word. He now tells us that "I am still opposed to the term, but resigned to *others* using it."

Alternate Spellings Suggested

To avoid the connotation of "rock" chemicals that might perhaps be derived by the uninitiated, the etymologists, and the purists, some persons have suggested several alternate spellings.

Some of these include petrolchemical, petrolochemical, and petroleochemical. In this connection, one of our dictionary editors points out that, if a word such as petrol (oil) chemical were used, the special meaning of petrol as gasoline would create almost as much confusion.

Others have suggested that the phrase "chemical from petroleum" ought to be used, or even "petroleum chemical." In either case the suggested phrase is more cumbersome to handle, and the second one has added disadvantage of not being specific as to whether it is a chemical from petroleum or a chemical used in connection with petroleum.

Whence It Came

Efforts to track down the origin of the term petrochemical haven't been too successful.

The one fact that we did come up with—and a most disconcerting one to us—was that we can't lay any claim to having fathered it. The first use of the term we could find in one of our journals was in the Sept. 4, 1944 issue of the *NPN Technical Section* (the predecessor to PETROLEUM PROCESSING). In that issue we carried an article under the title "The Coming Petrochemical Industry."

Prior to that there were numerous references in the *NPN Technical Section* to "petroleum chemicals" and the "petroleum-chemical industry" but no use of the word petrochemical.

Actually, and this we hate to admit, the first published use of the word we could locate was in the Jan. 25, 1942 issue of one of our dearest competitors. (Will you pardon us if we just whisper it?)* That issue carried a section on "Refining and Petro-Chemistry" which included a discussion of "petroleum-hydrocarbon chemicals" and the "embryonic petroleum hydrocarbon-chemical industry." One of the articles refers to the "new 'Petro-Chem' field" but that's as close to the word "petrochemical" as the editors came.

In that same issue, however, at least three advertisements included the term "petro-chemical." E. B. Badger & Sons referred to "Petro-Chemicals the new era for the petroleum industry." J. F. Pritchard & Co. quote a source as saying "The Petro-Chemical industry already goes far beyond the cracking and reforming arts and embodies all the steps involved in transforming petroleum stocks by chemical reactions into a multitude of useful by-products." And Joseph A. Coy Co. of Tulsa identified itself as "makers of Petro-Chemical Equipment" and talked about "the further development of petro-chemical processing."

The mere fact that three different advertisers used the same term at the same time would indicate some prior source from which they picked it up, but what that is we haven't yet determined.

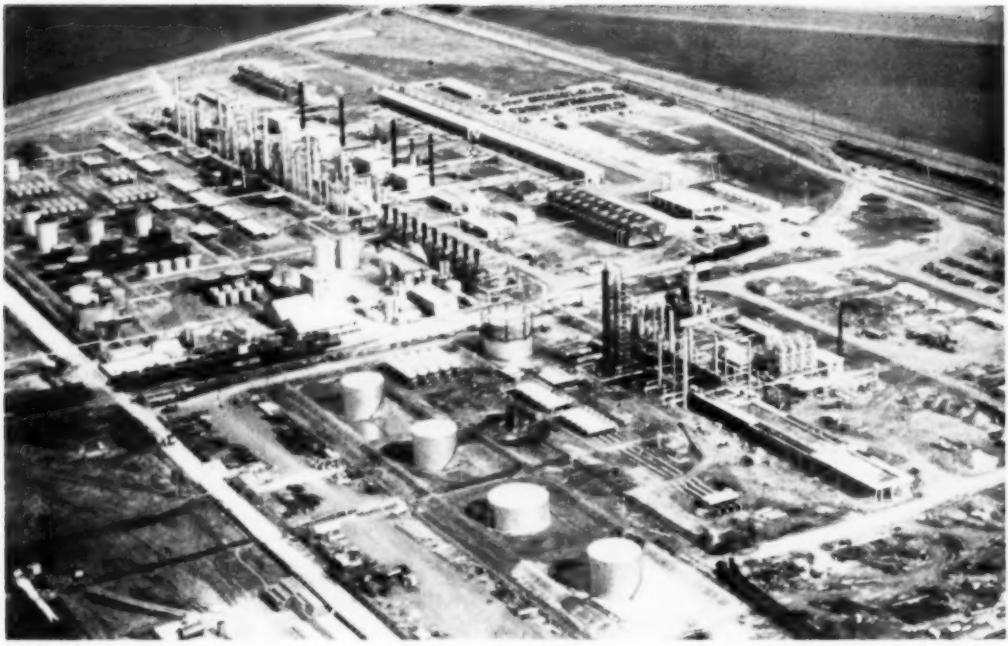
Although the definition we've worked out and are submitting to our readers may not prove to be the one finally adopted for general acceptance, we're certain of one thing. The term "petrochemical" is here to stay at least as long as our supplies of petroleum and natural gas hold out.

* *Oil and Gas Journal*

What Do You Think

Chances are you don't agree with our definition of what a petrochemical is—or maybe you do. In any event we'd like to know. Write and tell us how you'd define the term.

Petrochemical Editor
PETROLEUM PROCESSING
1213 West Third St.
Cleveland 13, Ohio



STILL GROWING is the Chemcel plant of Celanese Corp. at Bishop, Texas

How Big Will the Industry Grow?

Increased demand for synthetic organic chemicals opens up a fantastic future for petrochemicals

By V. B. GUTHRIE, *Editor*

WHEN a man sits down today to try to figure out how big the petrochemical industry may become, he finds himself raising his sights in an effort to vision how great the use of all synthesized products may become in years hence.

The petrochemical industry has many natural advantages and two big economic advantages, dependability of supply and stability of prices, for furnishing the chemicals which are used in hundreds of products that touch about every facet of our lives today. How great will be its actual contribution of these materials depends in large part on how much further we go in fashioning products through chemistry to improve living standards.

Statistics available today show that the partnership of the chemical and petroleum industries in making chemicals from petroleum has already grown into big business, in terms of dollars rather than the barrel units the oil companies deal in with conventional products. There are tangible indications, in new plants proposed and building, for a continued growth in petrochemicals for many years ahead. Looking even further ahead, the indicators are more intangible factors, but the expansion might dwarf even the present rate of growth.

The growth in population in this country is one tangible factor that points to a significant increase in the consumption of chemicals. If the growth is maintained at the present rate of 1.5% a year, the cumulative effect well might create an additional market for many hundred million pounds a year of chemical products. The upgrading of incomes which has been going on for the past decade or so also will have its effect in enlarging the markets for things made from, or by means of, chemical products, to improve living comforts of the larger population.

In the raising of food the use of synthetic products to stimulate growth and improve quality is believed only to have started. We already have fertilizers and weed killers and we use chemicals to improve the flavor and color of fruits and vegetables. One chemical company has recently announced a soil restorer, a petrochemical, which reconditions soil in a matter of days as compared with months or years if nature has to be relied upon. It may have great possibilities in the reclamation of present arid lands. Another company believes it has found a rapid, inexpensive continuous method for making fresh water in large volumes from seawater. A plastic from petroleum is an important item in the equipment for doing this.

When we think of food requirements today we think of petroleum derivatives. Walter S. Carpenter, Jr., board chairman, of the duPont company, told an audience at the 50th anniversary of the Spindletop oil field in 1951. He included "the new fungicides, insecticides and pesticides for the con-

trol of the wide variety of destroyers which decimate the crops in the field and granaries of the nation. We think of materials to treat our seeds to insure better germination and nitrogenous fertilizers to stimulate their growth, and other chemical products to provide low temperature storage for perishable foods. Looking a little forward, we think in terms of the new amino acids, the building blocks of the proteins, to supplement the proteins of the vegetable and animal world. Here we may have developments one day of great significance."

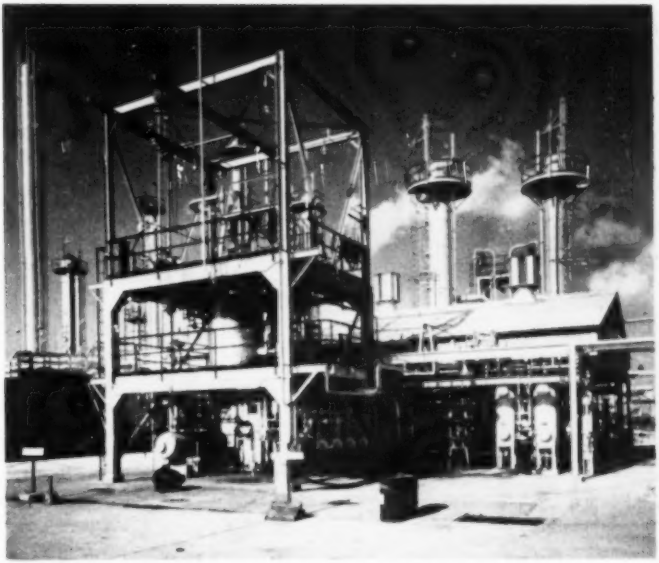
The more recent developments in synthetic fibers to replace or use with natural textiles have already been important enough to make the Director of the Textile Research Institute, at Princeton, tell the Synthetic Organic Chemical Manufacturers Assn. recently, "I am excited about the future of the chemical industry in the textile field and I think you should be also." Those who solve the present weaknesses of the synthetic fibers will stand to profit enormously, he said, "for they are working on that great market of textiles which combines the essentials of human clothing with the non-essential but powerful vanities of decoration and style".

To date, authorities in the plastics industry state, about 30 basic plastic materials have been developed which lend themselves to hundreds of formulations, which makes it possible to tailor-make plastic materials for specific uses. The production of synthetic resins to the present estimated volume of 2,600,000,000 lbs. in 1952 is more than three times the 1945 output and further expansion is planned. Wartime applications, to solve shortages, developed many peacetime uses. Industry uses plastics in housing, gears, piping, tools, ducts and many other forms. The war-developed moulded reinforced plastics are used in furniture, luggage, flooring, table and counter tops, toys, automotive parts, aircraft fuselages. Plastic films and sheetings go into furniture covers, draperies, table cloths, window and shower curtains, and numerous other items. Plastic coatings on paper, wood and fabrics add to the durability and appearance of furnishings and fittings.

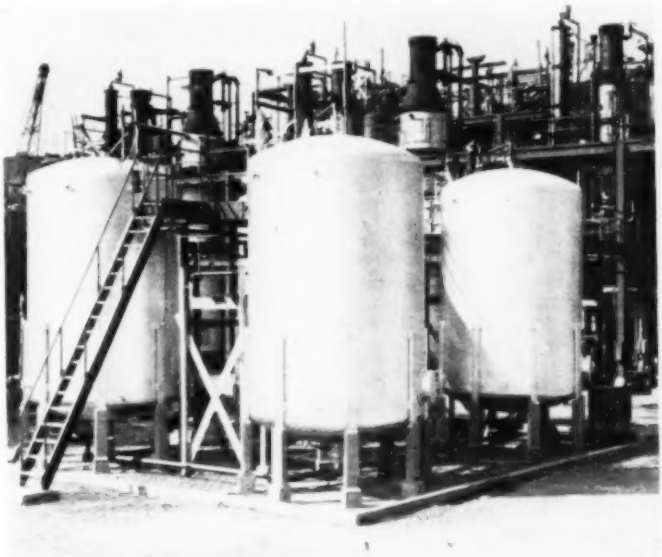
All these uses for plastics are capable of great expansion. One chemical company executive said of them, maybe over-enthusiastically, "People just don't know how good they are and how cheaply they can be made."

The production of synthetic detergents to take the place of soaps made from natural fats and oils has grown from 2,000,000 lbs. in 1935 to an estimated 2,000,000,000 lbs. by 1955, when the output of the synthesized product will be about equal to that of natural soaps. Technicological improvements are now opening to synthetics the field of the so-called heavy soaps, used in laundries and cleaning establishments, it is reported. Looking further ahead, one authority says, "Over the horizon is a day when all refinable grades of fats and oils will be reserved for food production, and the petroleum-derived synthetics will fill the gap."

Another factor that will increase our consumption of chemicals in the future lies in the increasing number of chemical engineers now being graduated from scientific schools and finding occupation in numerous in-



HEXYLENE GLYCOL unit at Shell Chemical's Houston plant. Hydrogenation reactor is in left foreground. Hexylene glycol is a propylene derivative used in brake fluids, cutting oil formulations and dry cleaning solvents



ETHYLENE OXIDE produced in these units at the Institute, W. Va. plant of Carbide and Carbon Chemicals Co. is the basic material for making ethylene glycol, polyethylene glycol, Carbowax compounds, and Cellosolve and Carbitol solvents

dustries of all kinds. There will be vastly more members of this nation who were trained as chemists and chemical engineers in 2001 than there are now in 1951, said President James B. Conant of Harvard. "The growth of the chemical profession within the lifetime of many of us has been one of the amazing social phenomena of our times," he said. "It takes no crystal ball to show that this chemical revolution will affect the balance of the century." These larger numbers of chemical engineers not only work in research and development to find new synthesized products and markets for them, but they introduce into industry itself new manufacturing techniques that call for large amounts of chemicals in processing operations. The petroleum industry itself is a good example. In the production as well as in refining, the consumption of chemicals to improve operations has greatly increased. This same change is taking place in many other industries.

Looking into the future, into this period of further expansion of the chemical markets, some authorities are worried over how the plants to meet these new needs will be financed in view of the present financial position of the chemical companies. Felix Williams, of Monsanto Chemical Co., told the Manufacturing Chemists Assn.: "Recent studies made in Washington indicated that the supply and demand of basic chemicals will be in approximate balance by 1955, even after making allowances for expansion at the present abnormal rate.

"The thinking seems to be that most of the basic programs have already been taken care of. Even if true, there remains a vast area without adequate means of financing.

"For instance, the future is described as a race between population growth and food production in which chemicals are a must. Our national textile fiber supplies will be inadequate without synthetic fibers. Our dwindling natural resources must be supplemented with chemicals, such as plastics. Agricultural chemicals represent another field with a tremendous future. Even the soil is badly depleted. While provision, through tax amortization, has been made for expansion of basic chemicals, no such provision is made for chemicals needed for the new and replacement markets. Expansion in these areas will require billions. Where is the money coming from?"

In short, it seems that, so far as demand is concerned, the petrochemical industry in this country faces a greatly expanded future, limited only by its ability to create by synthesis the products that replace, or supplement, or are used with natural materials to the end of improving living comforts.

Stability of Supplies and Prices Are Petrochemicals Big Assets

NO ONE in the petroleum industry at least, will question that the volume of materials for making chemical products from petroleum and natural gas is practically without limitations. For the long-term future, crude oil reserves in the U. S. are increasing. Gas reserves in the southwest are equivalent to a 30-year supply at present rates of consumption. Continued extensive exploration will increase both oil and gas reserves in this country, and the vast Canadian reserves may play an important part in the future.

Since the start of commercial petrochemical operations in the '20s this availability of large supplies of hydrocarbon raw materials has tended to create a stability in supply and prices of petrochemicals that has been a considerable factor in their expansion.

Dr. Wayne E. Kuhn, Manager of the Technical and Research Division of The Texas Co., has estimated the output of petrochemicals by 1962 will be close to 61,000,000,000 lbs annually, and will amount to about 50% of the total chemicals output in this country. This estimated growth is about in line with a statement of H. H. McClure, vice president of Carbide and Carbon Chemicals Division of Union Carbide and Carbon Co. to the effect the petrochemical industry has almost doubled in five-year periods in the past and that this rate of growth apparently will continue for some time into the future.

This greatly increased output of petrochemicals by 1962 will take only about 1% of our petroleum and natural gas production of that time, Dr. Kuhn estimates. The volume that will be going into petrochemicals then could be greatly increased without affecting conventional refinery operations to any noticeable extent.

A good share of the raw materials for the manufacture of chemicals coming from refineries today is in the form of gases from cracking, polymerization and similar operations. While the gases are incidental to these refinery operations, they are not by-products and they do not carry a by-product price unrelated to prices for other refinery products. The refiner can make the gases into other marketable products if they are not used in the manufacture of petrochemicals, such as motor or aviation gasoline components or liquefied petroleum gas.

In practice refiners value the gases incidental to cracking for petrochemicals at at least their value as components of gasoline or some other standard product. Some companies assign a market value to the petrochemicals they make in the same manner as for standard products. One company making ethylene from gases from catalytic cracking charges the ethylene operation its share of the portion of the cost of a barrel of crude represented by the charge stock to the cracker. It is also charged with the cost of separating and purifying the ethylene from the by-product gas. To this direct cost of manufacture is added all the indirect costs, including short-term amortization of the equipment, and the amount the company figures as profit.

Some oil companies do not produce sufficient gas from cracking or similar operations to meet their needs for this raw material for petrochemical manufacture. They may buy ethylene, propylene, or some other hydrocarbon fraction on the outside. They charge their own operation in making the same material from their incidental gases at the cost of the purchased material if they don't figure their own cost direct. In some cases also refiners make gas direct by cracking naphtha or gas oil, to supplement their own incidental gas supply and set up a cost figure for that operation.

By one of the above or some other method the refiners successfully making petrochemicals today assign costs to their product in line with the cost of their other products and carrying the same stability. The existence of an ample supply of the petroleum raw materials, coupled with process improvements that have been made over a long term, also tends to hold down the cost of the petrochemical. Thus the wide fluctuations have been avoided such as have taken place in some chemicals derived from natural and other sources.

"Whenever and wherever a chemical has been manufactured from pe-

troleum to replace or supplement the supply from other sources, the general effect has been to lower prices and to stabilize them at a dependable level." Jan Oostermeyer, president, Shell Chemical Corp., told the Drug and Chemical Assn. of Missouri in 1950. He cited instances of some chemicals now made from petroleum.

Acetone, a widely used organic chemical, when made from wood distillation, or, later, by fermentation from corn or other agricultural products, varied in price from 12 to 25c a lb. In the early 1930's acetone began to be manufactured from isopropyl alcohol, in turn made from propylene, and in a few years petroleum acetone dominated the market, representing well over 90% of the product made in the U. S. By 1936, said Mr. Oostermeyer, the price had dropped to 8c and was 7c through most of the '40's, despite the pressure of war years, and in 1950 was selling for 7.5c. (Currently it is around 8.5c.) "In the past 15 years", he stated, "the average price of acetone has not varied by more than a penny or two due to the stabilizing influence of the petroleum source of supply."

During most of the 1920's he said, ethyl alcohol produced by fermentation of molasses, sold for around 40c a gal. In 1930 production of synthetic alcohol from petroleum started and the price dropped steadily to 23c in 1940. During the war and even after, because of the greatly increased demand, the price for alcohol went to over 90c. By the end of 1948 sufficient synthetic alcohol capacity to meet demand had been created and the price went down again and is now around 30c.

Taking glycerine as another example, Mr. Oostermeyer said its price was never stable when it was obtained as a by-product of the manufacture of soap from fats and oils. Fixed at 18c by OPA during the war, it went to 55c when controls were lifted, then settled to 40c. When Shell's synthetic glycerine plant went into production in 1948, the price became stable and settled to a recent price range of 30-35c.

As important to chemical manufacturers as the lower prices for the synthetic products, said Mr. Oostermeyer, is the dependability of supply and stability of price that accompanies them. Long-term contracts are possible at firm prices. "The entire market shares in this stability", he said. "Partly for competitive reasons, but particularly because of the elasticity of the synthesis route, its ability to expand when demand exceeds supply, tends to prevent shortages and runaway prices."

Conditions in the manufacture of petrochemicals from natural gas also contribute to a stability in their prices. However, the price of gas has been trending upwards for several years and some authorities say it will reach a point where the price for domestic fuel will be out of line for the manufacture of chemicals.

So far the petrochemicals produced from petroleum and natural gas have been mostly of the aliphatic type. An entirely new group of chemicals, the aromatics, will be opened up to the oil companies, to the extent that the plants now being built to make aromatics from petroleum and operated for defense purposes are later put into the production of petrochemicals.

Included in the aromatic petrochemicals from benzene will be phenol and styrene (plastics), DDT (agricultural chemicals), and dodecylbenzene (detergents); from toluene, TNT (explosives); and from xylenes, phthalic anhydride (plastics and plasticizers) and terephthalic acid (dacron). Aromatic hydrocarbons higher than xylene have not so far been produced commercially by the petroleum industry in a high state of purity, states one authority. Many of them are produced in sizeable qualities in crude mixtures and purification could be accomplished given the proper incentive.

"The growth of petroleum as a major chemical raw material has brought about a profound change in the character of the chemical industry," Max Neuhaus and Nolan B. Sommer, Jefferson Chemical Co., stated in a paper given recently before the American Association for the Advancement of Science, in Philadelphia. "While in 1925 aliphatic chemicals comprised less than one-third of the total organic chemical production, this had changed significantly by 1945 when about two-thirds of the total was accounted for by the aliphatics. At the present time this trend seems to be continuing, although it should be pointed out that huge volumes of various aromatics from petroleum are beginning to make their appearance."

H. E. Bramton-Cook, vice president of Oronite Chemical Co., (standard Oil Co. of Calif.) summed the outlook up in a paper given last fall before the National Petroleum Assn. "It appears that the traditional sources of supply for aromatic hydrocarbons of the by-products from metallurgical coke production have now reached their limit in almost all instances, whereas the dynamic growth of the consuming industries, notably plastics, will continue and the additional requirements will be

NYLON INTERMEDIATES are made in these high-pressure units at du Pont's Sabine River Works near Orange, Texas. Also produced at this plant from hydrocarbon raw materials are methanol (from natural gas methane) and polythene (from ethylene obtained by cracking propane)

supplied by the petroleum industry."

Benzene is the most important member of the aromatics group. Of the total 1951 estimated demand for benzene, chiefly for defense purposes, of about 250,000,000 gals., it was also estimated that benzene production from coke-oven sources could be increased only from 170,000,000 to 200,000,000 gals. annually. The Petroleum Administration for Defense has stated that production of benzene from petroleum would have to be increased to over 100,000,000 gals. within the next year and to reach 180,000,000 gals. by 1955.

Source of benzene and toluene and xylene in the petroleum refineries is the hydroforming units built during the last war to make toluene and the newer catalytic reforming processes. The technology of reforming has improved greatly in recent years and new plants could be constructed quickly and at reasonable expenditures of capital and equipment, say the refining engineers.

Where the Industry Stands Today And Who's Doing What in It

"THE manufacture of petrochemicals is a significant industrial trend", impressively states a placard in a window display on Fifth Ave. of a conservative New York banking house.

Men from the headquarters of oil companies in nearby RCA Center who walk by the window will take the declaration as an accepted fact. Many do indicate some surprise, however, that the petrochemical industry has already reached a point where the term is becoming a catchword in the investment banking field.

While a petroleum company, Standard Oil Co., of New Jersey, began making alcohols from petroleum raw materials as far back as 1919, a chemical company, Union Carbide & Carbon Corp., is credited with launching the petrochemical industry in the early '20's, through a group of their research people being sidetracked from their original problem. They had started out to find a way to make acetylene from natural gas, rather than from the common source, calcium carbide. In the course of their work they learned how to make ethylene, propylene and various other valuable materials. By combining these with other chemicals they made the compounds that formed the basis of the new industry, petrochemicals.

By 1925, the du Pont Company was engaged in the petrochemical industry through the manufacture from petroleum sources of some of the components for tetraethyl lead, the then new anti-knock compound. Its activities have steadily widened since.

Among the petroleum companies, Shell Oil Co. started at an early date and is now a principal producer, operating six petrochemical plants, through the Shell Chemical Corp. which was organized in 1929. The Standard Oil Co. of California in 1943 organized the Oronite Chemical Co. to take over what had been its specialty division. During the war it was an important producer of petrochemical products for the military services and it has since enlarged its line with detergents, additives and other products.

Engaged in the petrochemical industry today are over 70 oil and chemical companies, operating or building some 130 plants. Its investment in 1952 is estimated at not far from $2,000,000,000 and total sales were around 17,000,000,000 lbs. of chemicals with a sales value of $1,600,000,000. Various authorities believe the industry will increase fourfold in the coming decade and that its 1962 output will be around 64,000,000,000 lbs., from plants calling for a total investment of $8,000,000,000.

The important chemical companies of the country who are active in the petrochemical business are listed in Table I, and their 1950 sales and financial position shown. The number of plants listed and other data covers all operations of the companies as it is not possible to separate petrochemical operations. The table brings out the wide variety of original interests of the chemical companies now producing petrochemicals including the making of whiskey, alcohol and explosives.

Over 50 major new petrochemical projects have been certified for accelerated amortization for tax purposes by the Defense Production Authority, as shown in Table 2, at a total investment cost of nearly $340,000,000. The chemical companies are considerably more active in the new plant construction field than the oil companies.

Technological interest in the new plants centers around two projects being located well in the interior of the country, to recover chemical products from natural gas transmission lines serving the east. While as accessible to their raw material as though they were located in the natural gas producing areas of the southwest, they will be closer to their markets.

In a joint venture of Mathieson Chemical Corp. and Tennessee Gas Transmission Co., the gas company built a $12,000,000 stripping plant on its gas line near Greensburg, Ky.,

Table 1—Old Line Chemical Companies Now Active in Petrochemicals

Company	Date of Initial Enterprise	No. of Chemical Plants in U. S.	1950 Net Sales	Net Worth**
Allied Chemical & Dye Corp.	1920 coal tar products and petrol.	20	$ 486,942,280*	$ 247,580,994
American Cyanamid Co.	1907 making calcium cyanide	13	222,334,144	166,446,810
Celanese Corp. of America	1918 chemical manufacturing	12	232,851,942	178,026,700
Commercial Solvents Corp.	1919 making synthetic butanol	7	90,250,942	54,530,514
Diamond Alkali Co.	1920 sodium cyanide related products	11	93,202,321	45,995,911
Dow Chemical Co.	1897 recovering chemicals from brines	10	220,851,185	218,955,851
E. I. du Pont de Nemours & Co.	1802 manufacture of explosives	70	1,297,433,343	1,240,902,337
Eastman Kodak Co.	1901 photographic raw materials	7	861,380,000	656,234,780
Hercules Powder Co.	1912 manufacture of explosives	8	189,240,744	74,067,751
Koppers Co., Inc.	1915 crude, refined coal tar products	24	212,497,377	81,845,184
Monsanto Chemical Co.	1901 making saccharin	12	227,436,206	104,885,500
National Dist. Prod. Corp.	1933 whiskey and alcohol manufacturing	13	189,877,342	253,014,588
Mathieson Chemical Corp.	1892 alkalis and basic chemicals	10	75,775,757	56,500,755
Rohm and Haas Co.	1909 manufacture of resinous products	4	81,272,647	42,746,934
Union Carbide & Carbon Co.	1917 manufacture of industrial gases	11	738,253,530	534,845,070
	TOTALS	258	$5,094,251,782	$3,830,288,777

* Gross Sales
** Capital Stock and Surplus

where it now processes several hundred million cubic feet of gas daily to extract liquid hydrocarbons consisting of ethane, propane, butane and natural gasoline. The hydrocarbon stream is piped to a $17,000,000 chemical plant at Brandenburg, Ky., built orginally by Mathieson Hydrocarbon Chemical Co. but since acquired by Mathieson Chemical Corp. This plant started making liquefied petroleum gas in December, and early this year started to manufacture some organic chemicals.

The National Petro-Chemicals Corp. (owned 60% by National Distillers Products Corp. and 40% by Panhandle Eastern Pipeline Co.) is building a plant near Tuscola, Ill., which will recover ethane and other hydrocarbons from natural gas moving through the Panhandle line. The extraction and fractionation sections are scheduled for completion late this fall. Chemical units for conversion of the ethane into ethyl alcohol and ethyl chloride will be in production in 1953.

In addition to ethane, other hydrocarbons to be stripped from the gas will be propane and butane, to be marketed as liquefied petroleum gas, and isobutane, used in the manufacture of aviation gasoline. A small amount of natural gasoline will also be produced.

Some authorities believe that the trend in the construction of petrochemical plants in the future will be to locate them considerably to the north of the oil and gas producing areas in the southwest, and about halfway between their raw materials and their principal markets in the east. "This is a natural strategic location for chemical plants", stated one chemical company executive. "The raw materials will be available by pipeline in these northerly locations, or from refineries drawing their raw materials from oil pipelines. Transportation of products is frequently a more important item to chemical companies than to the petroleum industry which to such a large extent supplies its own transportation systems. Consequently a more strategic location of the plant with regard to markets is necessary."

Market data on petrochemicals is compiled by the U. S. Tariff Commission at Washington, which covers the chemical field in general. The first published data on petrochemicals appeared in the Commission's report for 1943, as shown in Table 3, as reported by F. I. L. Lawrence, manager of specialty sales, Kendall Refining Co., Bradford, Pa., in a paper before the Chemical Market Research Assn. Table 4 gives production, sales, and sales value for 1950, also from the paper by Mr. Lawrence. The Tariff Commission's reports are based on data supplied by individual companies, both petroleum and chemical. Its "crude products from petroleum and natural gas" include the primary petrochemicals, aliphatic and aromatic and naphthenes.

It will be noted at once that the total shown for 1950, around 7,000,000,000 lbs., is less than half the 15,000,000,000 lb. figure the industry uses for the total output of petrochemicals in that year. The principal cause of the difference, it is believed, is that the industry total includes data for secondary petrochemicals of higher molecular weight than the primary derivative, as, for example, ethylene glycol made from ethylene. Also, the industry includes as petrochemicals those chemicals of which the larger portion is a petroleum or natural gas product, but also includes some other material. It is also likely the Tariff Commission's figures are not inclusive of all oil and chemical companies in the petrochemical field.

The figure the Commission assigns in its reports to "unit sales value" is made up from the sales and price reports received from individual companies. For each company an average is made up for each commodity based on its total sales. The figures given in the report are an average of the prices of individual companies.

Table 2—Petrochemical Plant Construction Projects Certified By The Defense Production Authority For Fast Tax Write-off

(Not including benzene, sulfur, synthetic rubber or carbon black plants)

Oil Company Plants

Company	Number Projects	Cost
Atlantic Refining Co.	1	$ 3,400,000
Esso Standard Oil Co.	2	6,040,000
Gulf Oil Corp.	2	18,132,000
Hancock Oil Co.	1	4,000,000
Lion Oil Co.	1	30,452,000
Phillips Chemical Co.	1	38,290,000
Shell Chemical Corp.	3	8,303,000
Standard Oil Co. (Indiana)	1	2,552,000
Total No. Projects	12	$109,139,000

Chemical Company Plants

Company	Number Projects	Cost
Commercial Solvents Corp.	2	$ 21,784,000
Diamond Alkali Co.	1	1,606,000
Dow Chemical Co.	6	22,200,000
E. I. du Pont de Nemours & Co.	4	15,228,000
Ethyl Corp.	3	18,535,000
Ethyl-Dow Chemical Co.	1	8,185,000
Hooker-Detrex, Inc.	1	1,491,000
Jefferson Chemical Co.	1	.....
The Koppers Co.	3	8,487,000
Mathieson Chemical Corp.	2	3,538,000
Math. Hydro-carbon Chemical Corp.	1	18,980,000
Monsanto Chemical Co.	3	18,940,000
National Petro-Chemicals Corp.	1	14,303,000
Rohm and Haas Co.	1	.....
Spencer Chemical Co.	1	13,758,000
Texas Eastman Co.	1	6,302,000
Union Carbide and Carbon Corp.	4	26,810,000
Wyandotte Chemical Corp.	1	2,624,000
Total No. Projects	42	$229,773,000

Table 3—Petroleum Products Used in the Chemical Industry, 1943

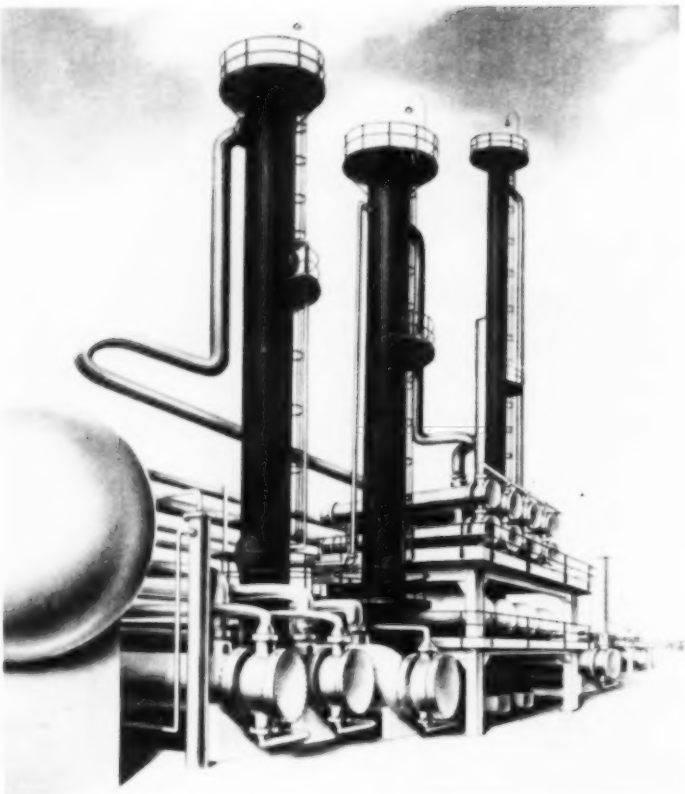
(From U. S. Tariff Commission)

Product	Production 1000 lbs.
Cresylic Acid	13,916
Naphthenic Acid	17,341
Butadiene	98,580
Ethylene	166,224
Propanes	394,620
Butanes	673,006
All Others	201,225
TOTAL	1,564,912

Table 4—Production, Sales and Sales Value, Crude Products from Petroleum and Natural Gas, 1950

(U. S. Tariff Commission)

Product	1950 Production 1,000 lbs.	1950 Sales Quantity 1,000 lbs.	1950 Sales Value $/lb.
Aromatics and Naphthenes			
Benzene, (except motor grade)	72,227	48,978	051
Cresylic Acid, crude	16,060	7,230	034
Naphthenic acids, total	24,684	12,554	097
Acid No. 225-249	6,248	7,031	108
All other	18,436	5,523	063
Toluene, all grades	329,112	237,227	031
Xylene, all grades	449,587	339,644	031
All other	548,571	530,132	046
Total	1,424,961	1,175,765	040
Aliphatic Hydrocarbons			
C_2 hydrocarbons: Ethane and ethylene	1,821,993	178,313	042
C_3 hydrocarbons, total	1,692,889	950,855	010
Propane	998,842		
Propylene and propane-propylene mixture	694,047		
C_4 hydrocarbons, total	1,638,849	1,435,219	051
1,3 butadiene, grade for rubber (elastomers)	810,956	601,943	083
1-butene and 2-butene	641,072	620,433	028
All other	187,021	212,843	027
All other aliphatic hydrocarbons, total	356,869	316,798	024
Diisobutylene	20,044		
All other	336,825	316,798	024
Total	5,510,100	2,881,185	034
Total aromatics and naphthenes	1,424,961	1,175,765	040
Total aliphatics	5,510,100	2,881,185	034
Grand Total	6,935,061	4,056,950	036



ARTIST'S CONCEPTION of new Udex unit at Eastern States. Three central columns are (l to r) extractor, stripper and benzene recovery column. Slender column at far right probably is a glycol still, to drop undesired water from the system. Surge drum shows at left.

First Udex Unit Recovers Benzene

New solvent extraction process for separating aromatics put in by Eastern States in Houston

By D. P. THORNTON, Jr.
Southwestern Editor

THE first commercial installation employing the new Udex Solvent Extraction process for the recovery of benzene was scheduled to be in operation at the No. 2 Plant of Eastern States Petroleum Co., Houston, by the first of this month.

It will operate in conjunction with a nominal 4500 b d Platforming unit specifically designed to produce an effluent high in aromatics from a naphthene-rich charge. The Platformer went on-stream last February and its ultimate capacity is believed by the operators to be in the neighborhood of 5000 b d.

When the Udex unit reaches full capacity, it will recover approximately 250 b d of benzene and a small quantity of mixed aromatic solvents from design feed of 1000 b d. By addition of another fractionator and suitable change in Udex feed, the separation between toluene and mixed xylenes also could be achieved. Benzene recovery from Udex feed is estimated at 99% or better.

Thus, with the completion of these facilities, it will be possible for what a few years ago was a small independent refiner to not only produce a superior motor fuel, but components for aviation gasoline and also enter the petrochemical field with benzene currently a scarce commodity. Further expansion in both directions is under consideration.

Udex Solvent Extraction

The Udex process for solvent recovery of aromatics is relatively simple. It also has the added advantage of using a relatively inexpensive solvent, the characteristics of which can be readily adjusted to meet requirements by varying its concentration with water. These characteristics change but slowly with temperature, thus permitting what amounts to isothermal operation, for practical purposes, without requiring precision temperature control.

The solvent reported by the process developers, Dow Chemical Co., and the licensors, Universal Oil Products Co., is "glycol." This is a commonly-accepted synonym for ethylene glycol. However, from several other reliable sources it has been learned the solvent is diethylene glycol (known also as glycol ether, melting at 13.1 F. and boiling at 472.6 F.), although this has not been officially announced. The cost reported by the

licensor for the glycol solvent is "about 20c per lb" in bulk, which compares with the currently quoted price for diethylene glycol in drums, carloads, of 20.25 to 21.25c per lb [1].

The "glycol" is diluted in controlled amounts with water to obtain a wide range of selectivity and solubility for the aromatics. The mixture has both high selectivity and good solubility properties over the entire range of aromatics involved, but is immiscible with paraffinic constituents over this same range.

Pilot plant tests with paraffinic mixtures containing as little as 10% aromatics (benzene, ethylbenzene, toluene and xylenes) show recoveries of above 90% of the aromatics, from which these petrochemicals can be recovered by simple low pressure stripping as an overhead product. The design figure for the Eastern States installation calls for a feed stream of 1000 b/d containing 25% benzene, of which approximately 99% will be recovered along with higher aromatics.

The glycol-water solvent boils at a considerably higher temperature than the aromatics. As the solvent-to-aromatics ratio is said to be "fairly high" (the exact range of usable ratios has not been released), this develops another operating advantage in that the solvent requires no heat of evaporation in order to effect its separation and recovery.

Aromatics From Platforming

In order to describe the Eastern States benzene recovery operation it is necessary also to consider the Platformer (Fig. 1), since the two units are tied together processwise. Nevertheless it is possible to run them independently, each on blocked operation, or to shut down the Udex unit completely.

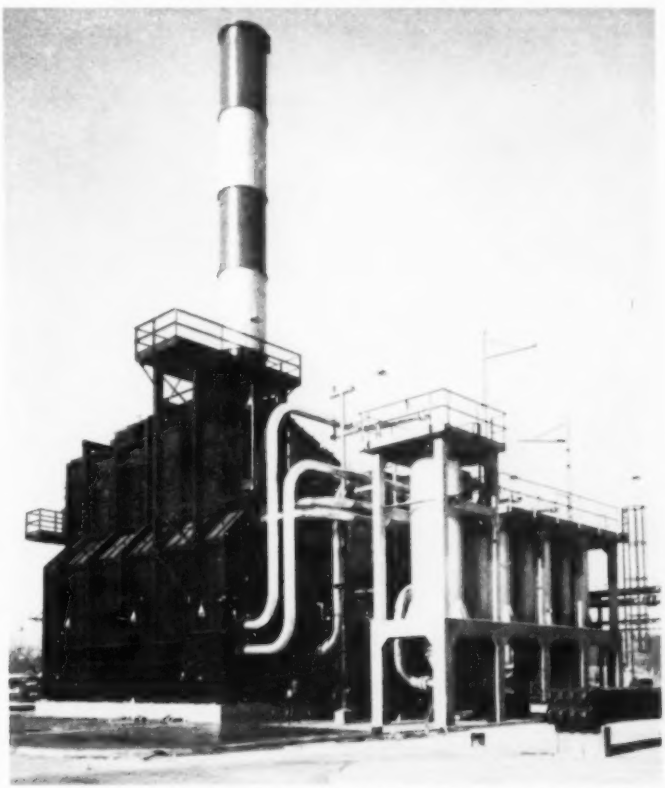
Eastern States' Platformer is in general conventional, except that it is designed to operate on a feed high in naphthenes. A major portion of the crude processed at the refinery is naphthenic and high-sulfur, coming from Poza Rica, Mexico.

The theory behind the Platforming process, together with data from pilot plant and commercial operations in both gasoline and aromatics production, all have been adequately covered by others [2, 3, 4] and will be only briefly alluded to here.

The unit is designed to handle 4500 b/d of a depentanized, 350 F. end-point straight-run gasoline for the production of aviation gasoline base stock. In motor fuel operation the same quantity of a depentanized 400 F. end-point straight run stock is charged. A special prefractionator taking a C_5-and-lighter overhead cut, Platformer charge side-cut and a heavy bottoms (to storage) product has been installed.

The Platformer proper has four re-

GENERAL VIEW OF PLATFORMER showing (l to r) charge and interheater furnaces, platformate stabilizer, rerun column, prefractionator, and Udex feed preparation column. Small white tower in front of latter is part of the tripotassium phosphate desulfurizing unit.



REACTOR SECTION, showing the four platformer reactors, with interheater at left. Flow through the reactors is successively from right to left.

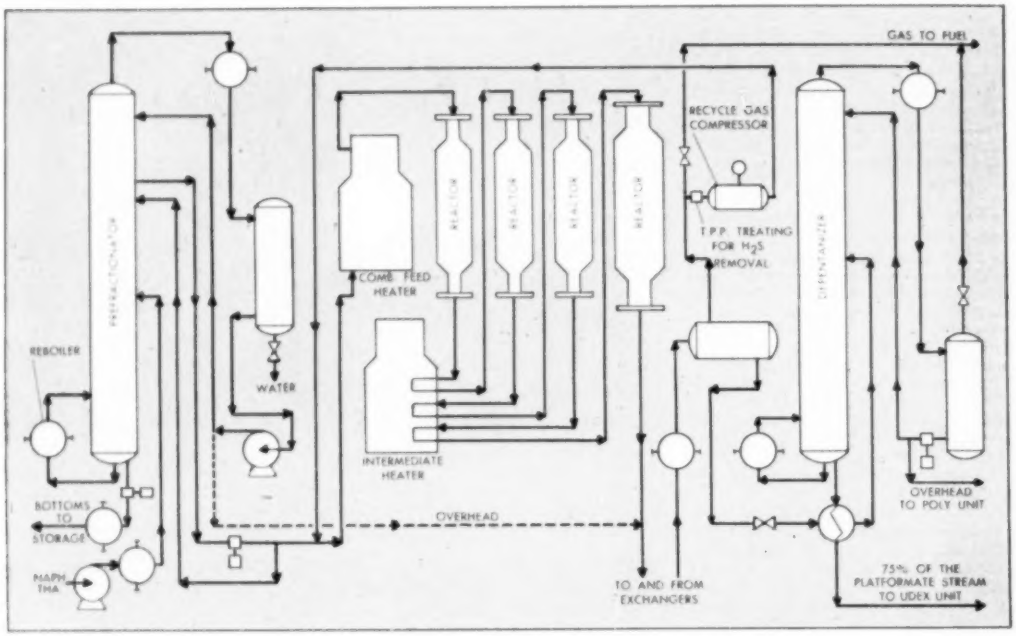
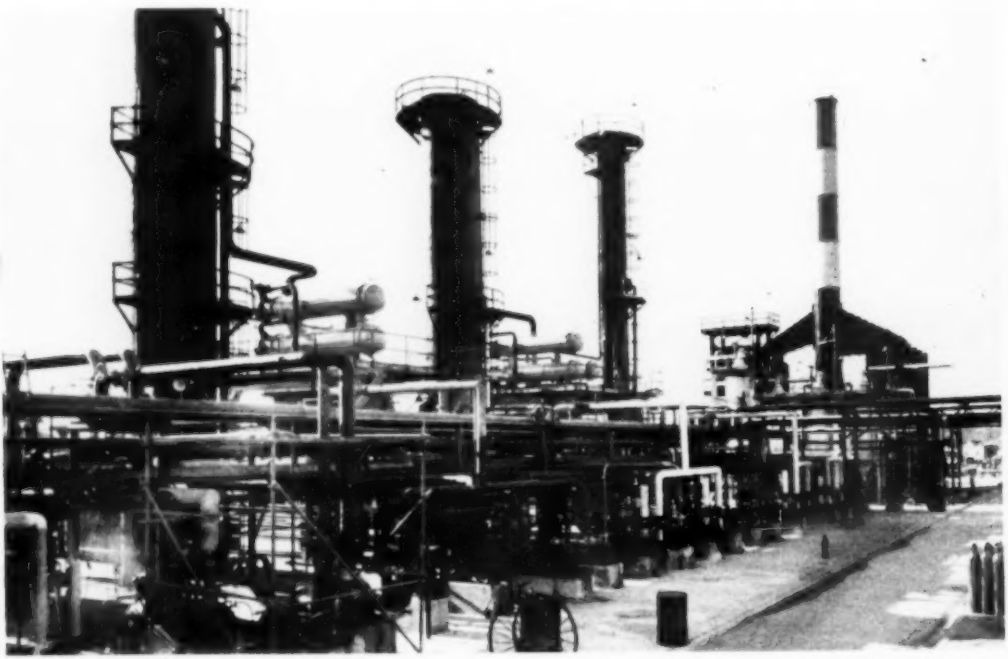


FIG. 1 Schematic flowsheet of Eastern's Platforming unit



FRACTIONATION SECTION of Platformer. Columns (l to r) are prefractionator, rerun column, Platformate stabilizer. Reactors and heaters are visible at far right

actors in series, with provision for interheating. Two heaters are provided, one handling total feed and the other accommodating the three interheater coils; both are served by a common stack. The principal reason for the four reactors, rather than three as in earlier designs, is to provide closer heat control in the individual reactors.

Since the formation of aromatics from naphthenes and paraffins is endothermic (about 1000 Btu. per lb. of naphthenes and paraffins converted), several smaller reactors with interheaters between are preferable to one large reactor to secure the maximum utilization of each catalyst bed. Recycle gas, 80 to 90% hydrogen, is injected into the feed at 600 psi. just ahead of the charge heater.

Effluent from the fourth reactor is cooled and the liquid dropped out in a separator. The overhead gas, containing a high proportion of hydrogen, is sweetened with tripotassium phosphate in a conventional unit and returned through a compressor as hydrogen recycle. Excess is vented to plant fuel and supplies most of the heater load. The liquid product is depentanized (stabilized) and subsequently dehexanized in the Udex feed preparation tower. The heavier material remaining is rerun to split avgas blending stock from a heavy solvent naphtha. Operation in the Udex tower is such that all the benzene, together with some of the higher-boiling aromatics, are taken overhead. C_5 and lighter stabilizer overhead gases are fractionated in an existing unit.

Benzene Recovery

The Udex unit at Eastern States has been primarily designed for maximum benzene recovery. Consequently, the feed will consist predominantly of mixed C_6 paraffins and aromatics. Later, when and if it is desired to recover higher aromatics from the platformate, the end-point of the feed stock can be appropriately increased to include toluene and the xylenes.

As now designed, and as shown in Fig. 2, the Udex unit consists of an extractor employing a novel tray, especially developed by UOP for the purpose, a solvent stripper and an after-fractionator. Tray construction details are not available.

Extraction is counter-current, with feed entering near the bottom and glycol-water near the top. Somewhat above the point of solvent introduction a supplementary stream of water enters, this being the means of returning water recovered with the aromatics fraction overhead from the stripper. Very likely diversion of a portion of this stream, or supplementing it, serves at least in part as a means of controlling the proportions of glycol and water in the extraction solvent. However, the exact means for controlling this composition have not been stated.

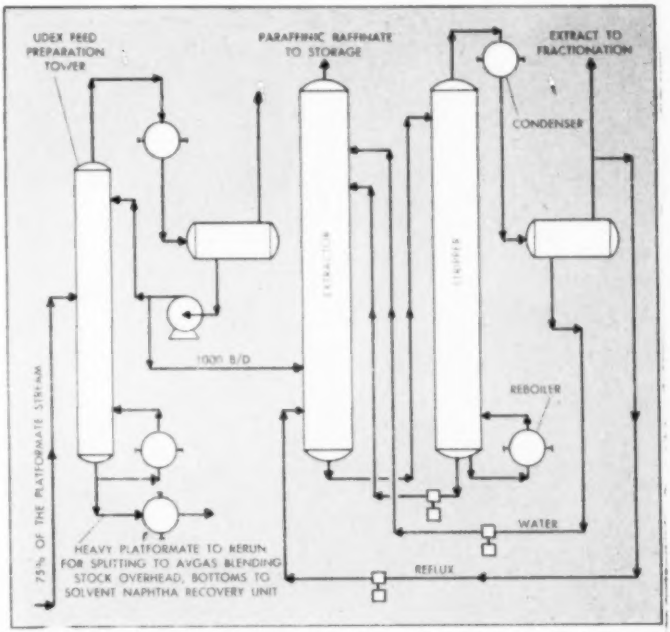


FIG. 2 Schematic flowsheet of new Udex installation at Eastern States

Near the bottom of the extractor a portion of the aromatics-rich extract from the stripper overhead is introduced as reflux. Raffinate, which is the paraffinic portion of the Udex feed, is removed overhead to storage. It has not been indicated that the raffinate requires solvent recovery beyond possibly a simple settling to recover any mechanically entrained solvent in the overhead.

The extractor operates at a pressure just adequate to maintain liquid phase conditions. Stripper bottoms are glycol-water mixture. The overhead is cooled sufficiently to permit maintaining a two-phase system, wherein the water and any glycol which may have vaporized is the heavier liquid and return to the system.

The aromatic phase is then fractionated to take industrial-grade benzene overhead. The heavier aromatics in the bottoms are available either for blending into avgas, further purification to separate out toluene and xylenes, or for disposal as aromatic solvents.

For the present, benzene production will be sold to Dow Chemical Co. for use at its Freeport, Texas, plant, where styrene and other benzene-derived chemicals currently are being produced.

Inasmuch as neither high temperatures or pressures are employed anywhere in the Udex unit, and neither the solvent nor the stocks handled contain corrosives or are themselves corrosive under the operating conditions used, carbon steel suffices for the equipment throughout the system. In the Platforming unit, alloy steel is required as a thin lining over internal insulation. This is intended primarily as a precaution against hydrogen attack on the external carbon steel shell. Heater tubes are alloy, but the balance of this system also is carbon steel.

Eastern States has further plans for future expansion into the petrochemical field, with the Udex facilities as a starter. Recently it organized the Eastern States Chemical Corp. to operate the Udex unit. Projected by this subsidiary is a unit for the production and recovery of ethylene from refinery light ends, as well as other units for petrochemicals production. These may include such materials as polyethylene, ethylene oxide, ethylene glycol and the like.

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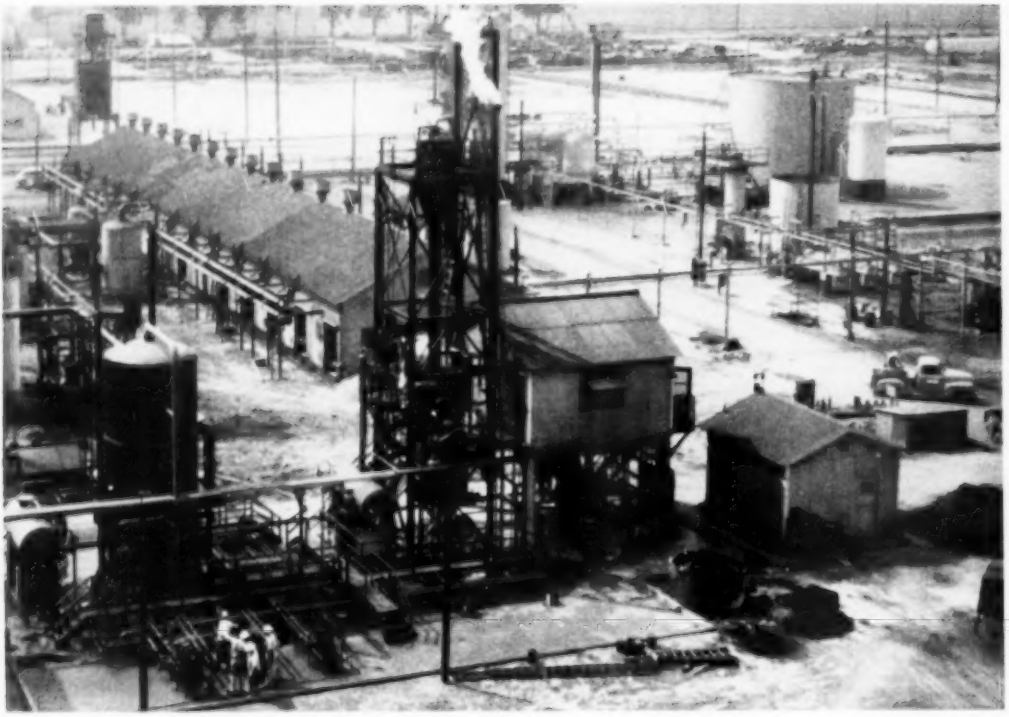


WASTE ACID SLUDGE-TO-AMMONIUM SULFATE plant at General Petroleum's Torrance refinery.

Fertilizer from Refinery Wastes

General Petroleum both reduces pollution problem at less cost and recovers valuable products

By **CHARLES G. BRAGG**
The Fluor Corp.

SINCE December 1950, the successful operation of an ammonium sulfate plant at the Torrance, Calif. refinery of the General Petroleum Corp. has simultaneously solved some of the problems of atmospheric pollution and waste acid sludge disposal, while producing about 10 tons day'of fertilizer grade ammonium sulfate. Additionally, usable fuel oil has been recovered from the acid sludge and several tons/day of hydrogen sulfide have been made available for elemental sulfur recovery.

Diligent original research, exhaustive pilot plant testing, intelligent process design, judicious equipment selection, and careful mechanical design and layout have all played significant roles in the success of a plant whose only "feed stocks" are materials which were formerly discarded as useless.

The waste acid sludge "feed stock" is derived from conventional refinery acid treating operations, and contains about 41 wt.-% H_2SO_4, 14 wt.-% water and 45 wt.-% oil. The other feed is a "foul" steam containing about 2% NH_3 and 2% H_2S. This steam comes from the stripping of process waters in order to condition them for disposal. The ammonia and hydrogen sulfide originate from the nitrogen and sulfur which occur naturally in California crudes. Catalytic refining processes convert them to these compounds.

Research and Testing

The presence of these two wastes in nearly the stoichiometric quantities required to neutralize the acid and therefore produce ammonium sulfate, suggested to General Petroleum that at worst the waste acid sludge could be neutralized and that at best a salable ammonium sulfate could be produced.

General Petroleum therefore undertook preliminary laboratory investigations, and they appeared promising. Based on these results, the Fluor Corp., Ltd., prepared engineering studies and estimates, and conducted supplementary research in its own laboratories. First studies were directed toward completely absorbing the ammonia in the acid sludge, in order that a stream containing only hydrogen sulfide and steam could be supplied to an existing H_2S absorption unit. While ammonia is not objectionable in such a unit, the ultimate destination of the absorbed H_2S was a Claus type sulfur recovery plant, where ammonia is undesirable.

Experiments showed that the am-

monia was completely taken up by the acid by merely blowing the "foul" steam through the waste acid sludge. Further, upon nearly complete neutralization of the acid, the resultant liquid split into two well defined phases, the upper an oil layer and the lower an aqueous solution of ammonium sulfate. These phases were easily separable by simple settling.

Now the atmospheric pollution problem appeared solved, and a usable fuel oil recoverable. Further studies were then made by Fluor in which the additional cost of recovering the ammonium sulfate as a marketable solid, fulfilling fertilizer specifications, was determined. This appeared economically attractive as an incremental operation, and only one further laboratory investigation remained.

It was decided to make a pilot plant test using Torrance waste acid sludge under conditions approximating the expected operating conditions. Reaction of the ammonia with the sludge, separation of the oil, and crystallization and drying of the solid ammonium sulfate were carried out under careful control.

This program was followed to make certain that there were no trace constituents in the sludge which would inhibit crystallization, or cause the production of a crystal of insufficient size or one containing unsuitable occlusions. This work was carried out by the Struthers-Wells Corp., builders of the "Krystal" crystallizer, at their Warren, Pa. pilot plant, and was observed by a Fluor representative. The crystals yielded by these tests were analyzed and found to meet fertilizer specifications. The decision to build the plant was then made by General Petroleum.

Process Description

A brief description of the flow scheme shown on the accompanying diagram is given here, together with some comments on the major equipment items:

Fouled steam and waste acid sludge are introduced near the bottom of the reactor and flow upward through recycled ammonium sulfate liquor and oil from the sludge. Steam and H_2S pass overhead to atmospheric condensers where the steam and some hydrocarbon oil stripped from the sludge are condensed. This condensate and the non-condensable H_2S are separated in the condensate accumulator. The condensate contains some H_2S and is recycled to the foul water strippers. The H_2S goes to an absorption unit. Hydrocarbon oil is pumped off batch-wise to fuel oil.

The feed rate of the waste acid sludge is determined by the acidity of the circulating ammonium sulfate liquor. An acid content of about 0.5% H_2SO_4 is maintained as being the optimum for formation of large crystals, while assuring complete absorption of NH_3. The rate of recycle of sulfate liquor is determined by crystallizer heat requirements.

The reactor level is held constant by a fixed overflow outlet, and the mixture of ammonium sulfate liquor and oil flows to the oil separator. The oil is continuously pumped out to fuel, and the ammonium sulfate liquor flows to the crystallizer.

The crystallizer consists of two vessels, a crystal suspension basket below and a vaporizer above, connected by a barometric leg. A circulating pump lifts the liquor up to the vaporizer. Liquor temperature is maintained at 150°F. and a steam ejector maintains an absolute pressure of 140 mm Hg. on the system. Evaporation of water takes place in the vaporizer and the supersaturated liquor flows downward to the crystal suspension basket where the supersaturation is released on the crystals already present, causing them to grow to optimum size.

The circulation of solution through the suspension basket keeps the crystals classified and suspended. The saturated circulating solution is mixed continuously with feed from the separator at the suction of the circulating pump. This mixture goes back to the vaporizer where the cycle is repeated. Water vapor from the vaporizer is condensed in a surface condenser and noncondensable gases are removed by the steam ejector. Finished crystals are pumped as a slurry from the suspension container to the filtration equipment.

It is of interest to note here that where the sulfuric acid concentration exceeds 30%, the heat of reaction between gaseous ammonia and acid is sufficient to evaporate the water present, and the process is adiabatic. In this plant, the heat of reaction is carried from the reactor to the crystallizer by the recycle stream of ammonium sulfate liquor referred to before. A heater is provided in the crystallizer circulating line as an aid in start-up and for operating flexibility.

The filtration and drying equipment, supplied by Baker-Perkins Corp., consists of a slurry concentrator, a perforated basket "Tor Mear" type continuous centrifuge, and a hot air dryer integral with the centrifuge. The crystal slurry from the suspension basket is pumped to the slurry concentrator, a cone bottom tank with a vertical screw conveyor.

The concentrated slurry drops from the screw conveyor to the centrifuge where the crystals are dewatered to a moisture content of about 1.0%. The crystals are continuously discharged to the dryer where they are intimately mixed with a stream of hot air and dried to less than 0.1% water. The air is heated by passing it over extended surface tubes containing hot oil.

Overflowing liquor from the slurry concentrator and filtrate from the centrifuge drop into the mother liquor tank, and are returned to the reactor along with recycling overflow from the suspension basket.

Dry ammonium sulfate drops to a hopper. After a suitable batch has accumulated, a star valve feeds the salt into a pneumatic conveyor system which carries it to a concrete storage bin, where it is bulk-loaded into trucks.

Operating Variations

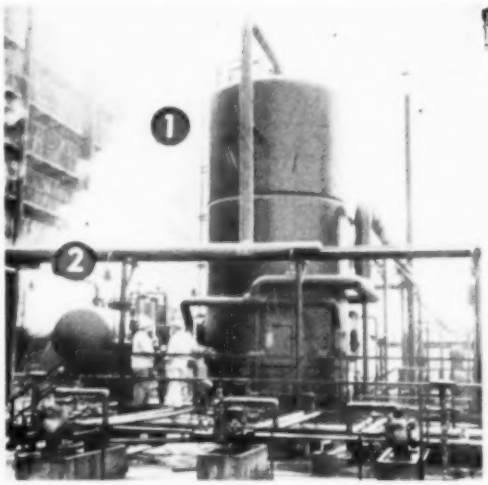
The plant has operated essentially as described above. No major difficulties have been experienced, but the following comments are pertinent.

1.—The waste acid sludge storage tank has a capacity of 10 days feed and is equipped with a 25 hp. propeller type agitator. Attempts to secure a uniform feed have been unsuccessful and the characteristics of

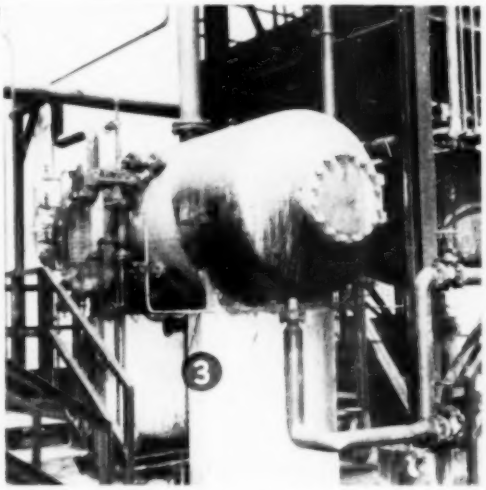
Meet the Author

Charles G. Bragg, senior coordinating engineer for the general sales staff of The Fluor Corp. Ltd. was graduated from Stanford University with an A.B. in Chemical Engineering. During 1941-42 he was with Mellon Institute of Industrial Research, investigating coal-tar products. From 1942 to 1945 he was with the Koppers Co. at their butadiene-styrene plant near Pittsburgh, as fuel system engineer and instrument engineer.

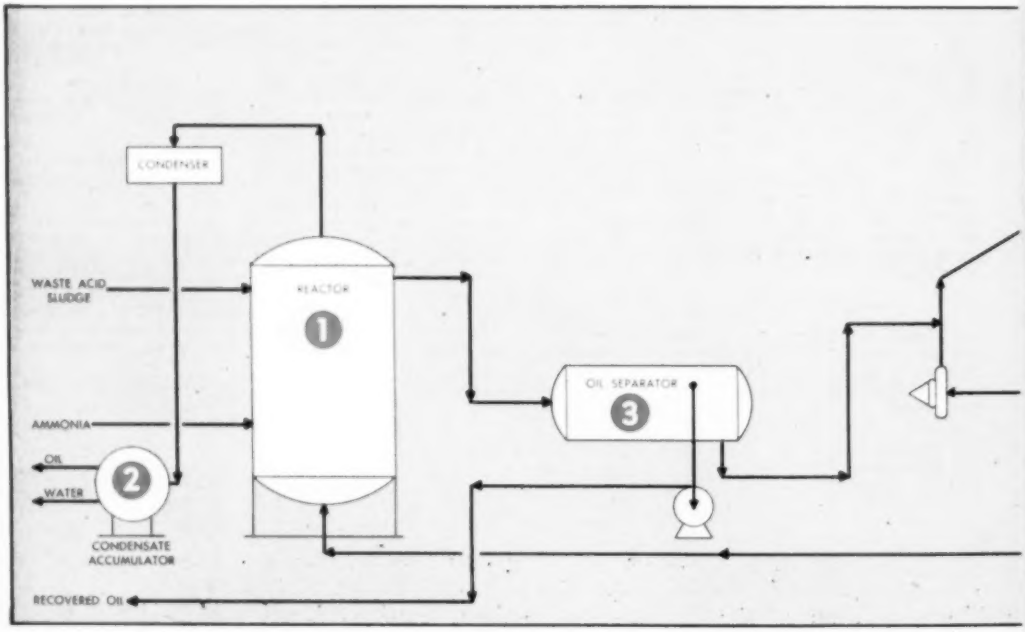
Since joining Fluor in 1946, Mr. Bragg's work has included instrument and project engineering, and process engineering on gas treating plants, sulfur recovery, and various inorganic chemical processes. He is an active member of the American Institute of Chemical Engineers and a licensed chemical engineer in the State of California.



REACTOR AND CONDENSATE ACCUMULATOR, (1) and (2). Sludge and ammonium sulfate reaction's overhead vapors are condensed to oil and water



OIL SEPARATOR, (3), where oil is removed from the sulfate liquor taken from the reactor and returned to the refinery for processing



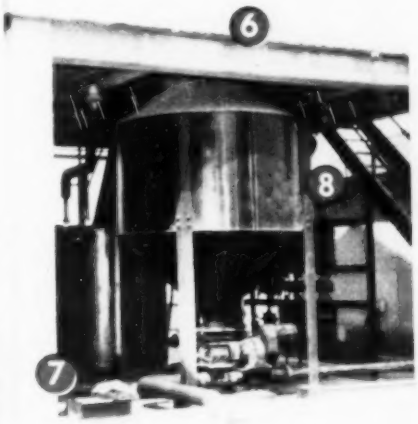
the plant feed have varied widely in acid content and oil content. However, the original design provided a large surge capacity in the reactor and variations in rate of acid or ammonia feed have been handled without difficulty.

2. It has been necessary to thin the oil in the oil separator by diluting it with a light fuel oil in order to make the mixture pumpable.

3. Moisture content of the salt product must be kept below 0.12%, or the salt "cakes" in the storage bin and causes unloading difficulties.

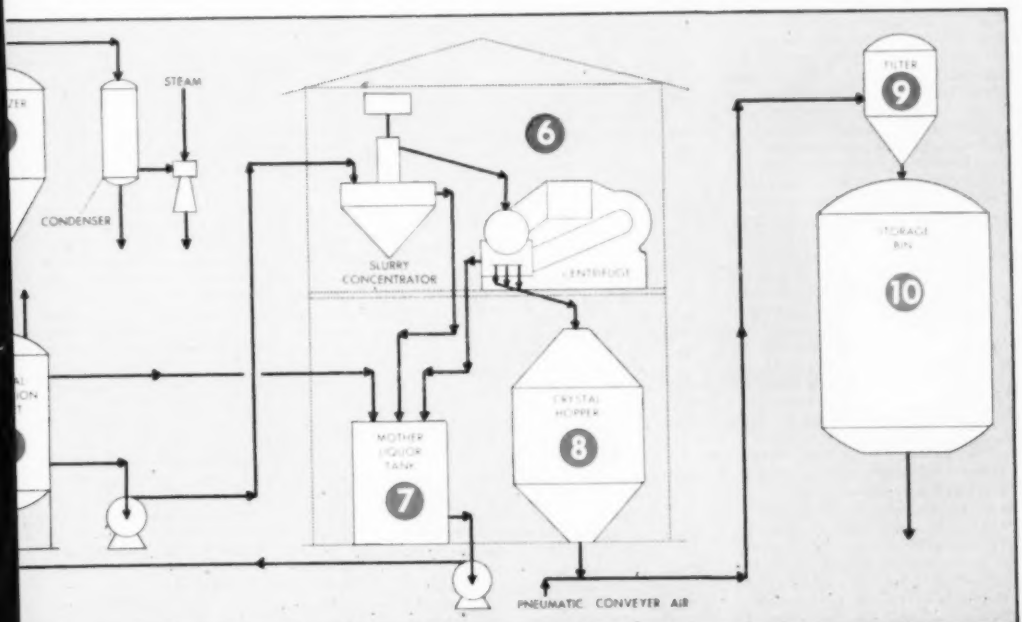
Vessels and piping containing aqueous ammonium sulfate are of type 316 stainless steel and pumps are "Worthite". The centrifuge and dryer are also of 316. Oil and sludge piping is carbon steel.

ZER AND CRYSTAL SUS-N BASKET, (4) and (5); g the complete crystallizer unit.



DRYING AND PRODUCT RECOVERY SECTION. The slurry concentrator and centrifuge are in the house (6). Excess liquor flows to tank (7). Crystals drop into hopper (8).

FINAL PRODUCTS are delivered to trucks from filter (9) and storage bin (10).



Conclusion

The specific problems solved by this plant may be summarized as follows:

1—Elimination of atmospheric pollution caused by free discharge of ammonia.

2—Elimination of expense of disposal of waste acid sludge.

3—Recovery of hydrogen sulfide for conversion to elemental sulfur.

4—Recovery of usable fuel oil from waste acid sludge.

5—Recovery of salable ammonia sulfate.

Credits

Process design of the plant was by General Petroleum, assisted by The Fluor Corp., Ltd. Mechanical design, purchasing, and construction were by Fluor.

How Can Market Research Help?

Successful selling requires careful study of all outside factors, chemical engineers' Institute is told

By WILLIAM C. UHL
Equipment Editor

MARKET research is a must for any chemical company of equal value to the newcomer in the industry and to the old-line manufacturer. It relieves waste and lowers product cost. It is good insurance against financial trouble. It guides expansion and long-range planning. It is useful to management, to sales, to manufacturing, to research and development, to engineering, and to purchasing.

These points were emphasized again and again by ten speakers in an all-day symposium on Chemical Market Research Problems and Practices during the regional meeting of the American Institute of Chemical Engineers in Atlanta, Ga., March 16-19. Papers on the program of significant interest to the petroleum and petrochemical processing industry covered such diverse topics as economic characteristics of the chemical industry; functions, organization, and administration of chemical market research; surveys of new products, and sources of information.

What is chemical market research? It is a staff activity which provides management an answer to "who — what — where — when?", according to Parker Frissell, of Dow Chemical Co., one of the symposium speakers. It tells

Who will buy *what* chemical in *what* quantities, of *what* quality, at *what* price, in *what* containers, against *what* competition, and *where* will it be bought, *when* and for how long.

Another speaker defined it tersely as "Chemical market fact finding for management action."

What is its value? In explaining the contributions market research has made to Dow Chemical's operations, Mr. Frissell explained that it has lowered product cost by: 1) scheduling and regulating manufacturing, 2) assisting in proper plant location, and 3) improving distribution of products. In doing this, it has prevented economic waste in the company itself, and in a larger sense, throughout the nation.

Additional values were cited in a paper by R. B. Wittenberg, manager, chemical division, General Tire & Rubber Co., which pointed out that beyond exploring and developing markets for new products, chemical market research has at least nine further roles in the modern chemical enterprise, among them:

1. Fact finding for the establishment of sales policies.
2. Analysis of distribution and merchandising methods.
3. Appraisal of sales performance and analysis of sales territories.
4. Fact finding for the selection of advertising methods and media.
5. Determining seasonal variations and market trends for scheduling production and controlling inventories.
6. Appraisal of projects considered for research to determine whether they have sufficient commercial value to warrant research effort.
7. Determination of the market potentials for new products and the volume and price at which they may be sold.
8. Market fact finding for guidance of commercial development.
9. General advice to management on trends, projects, and special situations.

Why is it valuable? Some of the economic characteristics of the chemical industry itself, as discussed by Maurice W. Leland, Shell Chemical Corp., helped underline the value of market research.

"An unusual situation in the industry is that there is no clear-cut definition or general agreement of where it starts and where it ends," he said. "Individuals working in some phase quite naturally emphasize their particular business and tend to minimize other aspects of the industry. Even the governmental agencies use different definitions in their inclusions, for example, in terms of familiar products. Is benzene a product of the chemical or the coal tar or the steel or the petroleum industry? Is rayon a separate industry or is it part of the chemical industry?"

The chemical industry can be described by a functional definition from an engineering viewpoint, according to Mr. Leland. The concept is that the industry contains three phases: 1) recovery of raw materials, 2) production of industrial chemicals, and 3) production of chemical products.

This breakdown divides raw materials into five groups: metals, non-metals, and those from coal, petroleum, and agriculture. It does not include two of lesser economic importance: air and water. The industrial chemicals are divided into only two broad classes: inorganic and organic. Chemical products run the gamut of typical known materials: adhesives, inks, explosives, paints, solvents, plastics, synthetic fibers and rubbers, etc. Obviously there are literally thousands of materials in each of the three phases.

Only in one of the five classes of raw materials—non-metals—is mining considered part of the chemical industry, since it is the principal supplier of these raw materials. In the other four classes, the bulk of the raw materials is also used for other purposes. They are therefore generally considered as other industries. However, from the chemical industry viewpoint, they are extremely important raw materials.

Complexity is the keynote through all three phases, although the analysis might imply great simplicity, particularly in the industrial phase. This complexity is one of the industry's important economic characteristics.

A second broad characteristic cited by Mr. Leland is that the chemical industry is dynamic. This means it is constantly growing and, simultaneously, making changes, substitutions, and its processes and products undergo rapid obsolescence. A few examples are the use of fertilizers, growing faster than food production; the penetration of synthetic rubber to over half of total rubber consumption; penetration of synthetic detergents to over one-third of the field of cleansing materials.

A third characteristic is that it is a service industry. It serves other industries instead of sending its products direct to consumers generally. This has created a heavy demand on technical manpower, for all phases — research, manufacturing, technical service, and selling.

The fourth characteristic is competition, and there are four types. One is between products; for example, isopropanol and ethanol compete for similar markets. Another is between processes; at least four processes are currently in use to make phenol from benzene. A third is between raw materials; ethanol from petroleum ethylene vs. ethanol from molasses; or phthalic anhydride from coal tar naphthalene vs. that from

petroleum ortho-xylene. And fourth is, of course, competition between companies.

How is market research done? There are no magic formulas nor short cuts. As the term implies, it is simply a sound engineering and scientific approach to obtaining facts. Actual methods apparently vary little, according to the reports made at the Atlanta symposium. Five basic activities or functions of Dow Chemical's market research organization were outlined by Mr. Friselle.

The first is the spot survey, a quick study to answer a set of broad questions to determine quickly whether or not to make a new product:

1. Where is the market?
2. What else is in it?
3. Where are their plants?
4. What are market prices, packages, etc.?
5. What are the freight problems?
6. Are there closely related or better materials already on the market?
7. Is the market shrinking or growing?

If the answers in the spot survey are favorable, the intensive survey is then undertaken. This adds to the above information:

1. Study of the history of the product.
2. Literature and patent search to locate likely customers.
3. Estimation of competitors and national capacity.
4. Study of the consuming industries (including, in many cases, calls on all known consumers and others in the same business as known consumers.)
5. An evaluation of the future of each major consuming industry.
6. Study of raw material availability.
7. An evaluation of the use of the product proposed.
8. Consideration of the general economic climate.

Sometimes it is desirable or necessary to make an area survey, to determine the business atmosphere and potential sales of an entire line of products in a specific geographical area. This indicates obtaining data on:

1. Population—number of, types of people, age groups, etc.
2. Number of industrial plants, number of employes.
3. Value added by manufacturing and type of manufacturing activity.
4. Income of the area.
5. Rate of growth.
6. Farms—area, number, income, crop types.
7. Location of potential customers.
8. Study of competitors—sales offices, plant locations, methods of distribution.

Dow uses a trade sales analysis system which keeps track of its competitors' activities and permits evaluation of a rational market. An especially-designed salesmen's call report provides information on purchases by his customers and potential customers of both his own and his competitors' products. These data are tabulated on I.B.M. machines and permit breakdown of the information by almost any classification or combination of classifications.

Providing periodic sales forecasts is the fifth major activity of the market research group. Taking the form of short or long-term forecasts, these can be based on the various data collected in the ways just described, or in combinations.

Where does it fit in management? Market research may be a function of the business enterprise itself, or it may be done by outside consultants, according to Mr. Wittenberg's paper.

If the needs are temporary and only a few specific problems are to be solved, the work might better be accomplished by an outside agency, he said. If the problem involves a large investment of new money, a company-employed market research director might not be objective enough, and an independent outside consultant's viewpoint may be preferable. However, if management can determine a full long-range program, it will be wise to establish a department within the company.

Its place in the corporate structure will depend largely upon the type and scope of its activities. If market research is required exclusively for work on new products, the department should be placed under the director of research and development. If it is wanted for work on existing products only, it should be placed under the sales director. However, if it is to serve all parts of the business impartially and objectively, Mr. Wittenberg recommends it report to top executives only.

How much manpower does a market research department need? In its simplest form, it will consist of a director and a secretary. As the work load grows, statisticians and field men must be added. At full growth, the organization will comprise a director, assistant director, statistician, cartographer, senior and junior field men, and secretarial help. The cartographer is a "production manager", responsible for the physical production of the final report, including the design and development of visual presentation material. Senior field men, who can be assigned to work on single projects with advantage, are needed chiefly on "manufacturer's goods" research. Junior field forces, which can be temporary hired, are helpful in large "consumer's goods" research projects, Mr. Wittenberg explained.

In answer to a question during the discussion period, Mr. Friselle stated that Dow Chemical's market research department consists of 12, including seven men and five girls for clerical assistance. Another speaker from the floor pointed out that a very small company can carry on market research very capably as a part of the regular work of the sales department.

The best market researcher is a man most easily described as a chemical-economist. There was general agreement on this point by all the symposium speakers. The leaders in the field have been chemists and chemical engineers with a bent for business and finance, men who have gone on to obtain graduate degrees in business, marketing, and economics schools. Experience-wise, they have served a number of years in both actual sales work and engineering or manufacturing operations, or perhaps research and development.

"What's New" Session Popular

HIGHLIGHTED information on new equipment developments—the subject of one session at the A.I.Ch.E. regional meeting in Atlanta—proved to be one of the best-attended programs during the entire conference.

Members who attended were virtually unanimous in agreeing that the idea was good and should be continued, according to early results of a questionnaire distributed to everyone at the session. It was also felt that the small, informal demonstration exhibits of some of the equipment described was helpful and should be continued.

The symposium on "What's New in Process Equipment?" was the first of what may prove to be a series on current progress in the design of process equipment. It was the intent to highlight only, rather than present intimate design details. The topics covered at Atlanta—mixing and process instrumentation—were selected as the result of a poll of members representing wide areas of interest in the field of equipment. The questionnaire used in Atlanta asked for preferences in other fields, including the various basic unit processes, as well as fluids handling, solids handling, materials of construction, etc.

Seven short papers were presented in a single afternoon. Four in the mixing field covered liquid mixers, dry solid blenders, paste mixers and kneaders, and high-pressure stuffing boxes. Three in the instrument field were on process control, dowtherm heater control, and controlled volume pumping of minute flows.

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U. S. Petrochemical Operations

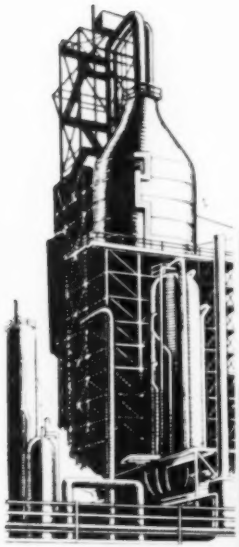
Compiled by the editors of PETROLEUM PROCESSING, the listing appearing on this and the following pages comprises the most complete directory of facilities in this country for the manufacture of petrochemical products, benzene, toluene, and xylene; sulfur; and rubber co-polymers. It tells where the plants are located, who operates them, the raw materials, and the finished products.

Petrochemical Plants in the United States

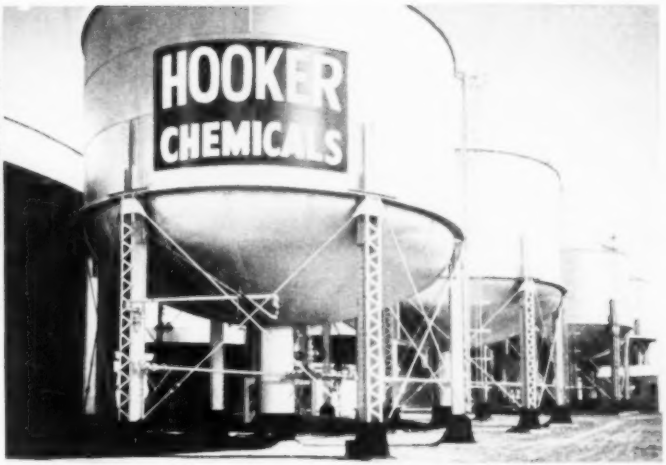
Company and Location	Hydrocarbon Raw Materials	Products	Remarks
Alamo Chemical Co. Houston, Tex.			Project never realized. Taken over by Phillips Chemical Co. See Phillips.
Allied Chemical and Dye Corp. (Barrett Division) Frankford, Penna.	petroleum fractions	phenol	New facilities.
Allied Chemical and Dye Corp. (National Aniline Division) Buffalo, N. Y.	kerosine	synthetic detergents	
Allied Chemical and Dye Corp. (Semet-Solvay Division) Buffalo, N. Y.	petroleum fractions	long chain alcohol wax	Benzene to be recovered as a by- product.
Allied Chemical and Dye Corp. (Solvay Process Division) Hopewell, Va.	petrolatum, natural gas	synthetic detergents, ammonia, methanol	New facilities; to be installed in mid 1952.
Allied Chemical and Dye Corp. (Solvay Process Division) South Point, Ohio	natural gas	ammonia, methanol	New facilities; to be installed in mid 1952.
Allied Chemical and Dye Corp. (Solvay Process Division) Orange, Tex.	ethylene	ethylene glycol, ethylene oxide	New facilities; scheduled for completion in 18 to 24 mos. Est. cost $5,000,000.
Alox Corp. Niagara Falls, N. Y.	petroleum fractions	oil additives	
American Petrochemical Corp. Lake Charles, La.	petroleum fractions	lube oil additives, cracking catalysts, ethylene, ethylene glycol and many other high volume petrochemicals	Joint venture between Cities Service Refining Corp. and Firestone Tire & Rubber Co. Plant not yet erected. Home address: 54 Wall St., New York 5, N. Y. Engineering details handled from this office.
Atlantic Refining Co. Philadelphia, Penna.	natural gas, petroleum fractions	anhydrous ammonia, synthetic detergents	
Atlantic Refining Co. Atreco, Tex.	petroleum fractions	synthetic detergents	
Bryton Chemical Corp. Trainer, Penna.	petroleum fractions	sulfonates	
Carbide & Carbon Chemical Co. Texas City, Tex.	natural and or refinery gases	synthetic organic chemicals including: methanol, ethanol, ethylene and diethylene glycols, ethylene dichloride, ethers, acetone, acetic acid, acetic anhydride, acetylene	Division of Union Carbide & Carbon Corp.
Carbide & Carbon Chemical Co. South Charleston, W. Va.	natural and or refinery gases	synthetic organic chemicals including: ethylene oxide, fluoroethylene	Division of Union Carbide & Carbon Corp.
Carbide & Carbon Chemical Co. Whiting, Ind.	refinery gases	industrial chemicals, e.g., ethylene oxide	Division of Union Carbide & Carbon Corp.
Carbide & Carbon Chemical Co. Institute, W. Va.	natural and or refinery gases	synthetic organic chemicals	Division of Union Carbide & Carbon Corp.
Carlisle Chemical Works, Inc. Reading, Ohio	petroleum fractions	lube oil additives	Current investment $2,500,000 plus.
Carthage Hydrocol, Inc. Brownsville, Tex.	natural gas	acetaldehyde, propionaldehyde, methanol, methyl ethyl ketone, ethanol, n-propanol, n-butanol, n-amyl alcohol, acetic acid, propionic and butyric acid, methyl propyl ketone	Petrochemicals produced as by-products of synthetic liquid fuel plant. Piped to adjacent plant of Standard Oil & Gas Co. for purification.

Company and Location	Hydrocarbon Raw Materials	Products	Remarks
Celanese Corp. of America Bishop, Tex.	propane, butane (natural gas)	methanol, n-propanol, formaldehyde, paraformaldehyde, acetaldehyde, acetic acid, acetone, butylene glycol, propylene oxide and glycol, dipropylene glycol	Additional facilities under construction; also building a unit to produce trioxane.
Celanese Corp. of America Pampa, Tex.	propane, butane (natural gas)	methanol, n-propanol, formaldehyde, paraformaldehyde, acetaldehyde, acetic acid acetone, butylene glycol, propylene oxide and glycol, dipropylene glycol.	New facilities under construction; est. completion date mid 1952. Brown & Root Engrg. Co. contractors.
Chemstrand Corp. Decatur, Ala.	methane	acrylonitrile	New plant under construction. Owned by Monsanto Chem. Co. (50%) and American Viscose Co. (50%).
Cities Service Oil Co. (Del.) Tallant, Okla.	natural gas	methanol, acetaldehyde, formaldehyde, and acetone	
Cities Service Oil Co. (Del.) Oklahoma City, Okla.	natural gas	methanol, acetaldehyde, formaldehyde, and acetone	Crude mixtures only; shipped to Tallant plant for purification.
Cities Service Oil Co. (Del.) Maud, Okla.	natural gas	methanol, acetaldehyde, formaldehyde, and acetone	Crude mixtures only; shipped to Tallant plant for purification.
Cities Service Refining Corp. Lake Charles, La.	refinery gases	butadiene	Government-owned butadiene plant.
Columbia-Southern Chemical Corp. Barberton, Ohio	ethylene	perchlorethylene	Formerly Columbia Chemical Div. of Pittsburgh Plate Glass Co. and Southern Alkali Corp. Now a wholly-owned subsidiary of Pittsburgh Plate Glass Co.
Columbia-Southern Chemical Corp. Natrium, W. Va.	petroleum fractions	perchlorethylene, chlorinated benzenes	Formerly Columbia Chemical Div. of Pittsburgh Plate Glass Co. and Southern Alkali Corp. Now a wholly-owned subsidiary of Pittsburgh Plate Glass Co.
Commercial Solvents Corp. Peoria, Ill.	propane (natural gas)	nitroparaffins	
Commercial Solvents Corp. Sterlington, La.	natural gas	anhydrous ammonia, methanol	Additional facilities under construction. Est. completion date, January 1953. Ford, Bacon, Davis Construction Corp. are contractors.
Continental Oil Co. Baltimore, Md.	benzene, propylene tetramer	synthetic detergents	Construction has been started on additional facilities to triple production. These operations were formerly performed by Sharples-Continental Corp.
Continental Oil Co. Ponca City, Okla.	petroleum fractions	lube oil additives	New plant construction. To be started in late spring; will take about 18 mos. to complete.
Cooperative Farm Chemicals Assn. Lawrence, Kan.	natural gas	anhydrous ammonia, ammonium nitrate, other ammonia fertilizers	New plant expected to be started in spring of 1952 and completed late in 1953. Owned by Consumers Cooperative Assn. of Kansas City, Mo.
Cosden Petroleum Corp. Baton Rouge, La.	butylene	butadiene	Government-owned butadiene plant.
Cosden Petroleum Corp. Big Spring, Tex.	refinery gases	numerous mercaptans	Mercaptans sold as natural gas odorants, and as raw materials for chemical intermediates for insecticides, detergents, and surface coatings.

Why Petroleum Refiners specify HOOKER



HOOKER CAUSTIC SODA distributing station at Wilmington, Calif., serves refiners in the area.



HOOKER CHEMICALS USED BY THE OIL INDUSTRY

Caustic Soda	Aluminum Chloride
Chlorine	Antimony Trichloride
Muriatic Acid	Sulfur Chlorides

Refiners use *Hooker Caustic Soda* for sweetening base stocks, and for neutralizing chemical wastes. They specify *Hooker Chlorine* for water treatment. *Hooker Muriatic Acid* is used for treating wells to improve production.

The other Hooker Chemicals listed above find wide use as catalysts in isomerization, polymerization, and treatment of hydrocarbon oils.

DELIVERIES

—Most of the Hooker Chemicals listed here are available now, some in limited quantities. Others will be available in the near future. Your Hooker sales representative will be glad to keep you posted on the current delivery situation.

Hooker offers your refinery:

- exceptional purity that reduces processing headaches
- uniformity assured through rigid control methods
- shipments carefully checked to arrive in good order, on schedule
- willing technical help on problems of supply
- experience as a supplier to 30 different industries
- a selection of nearly 100 industrial chemicals

Write today, on your business letterhead, for General Products List 100, and for Technical Data Sheets on Hooker Chemicals of particular interest to you.

From the Salt of the Earth

HOOKER ELECTROCHEMICAL COMPANY

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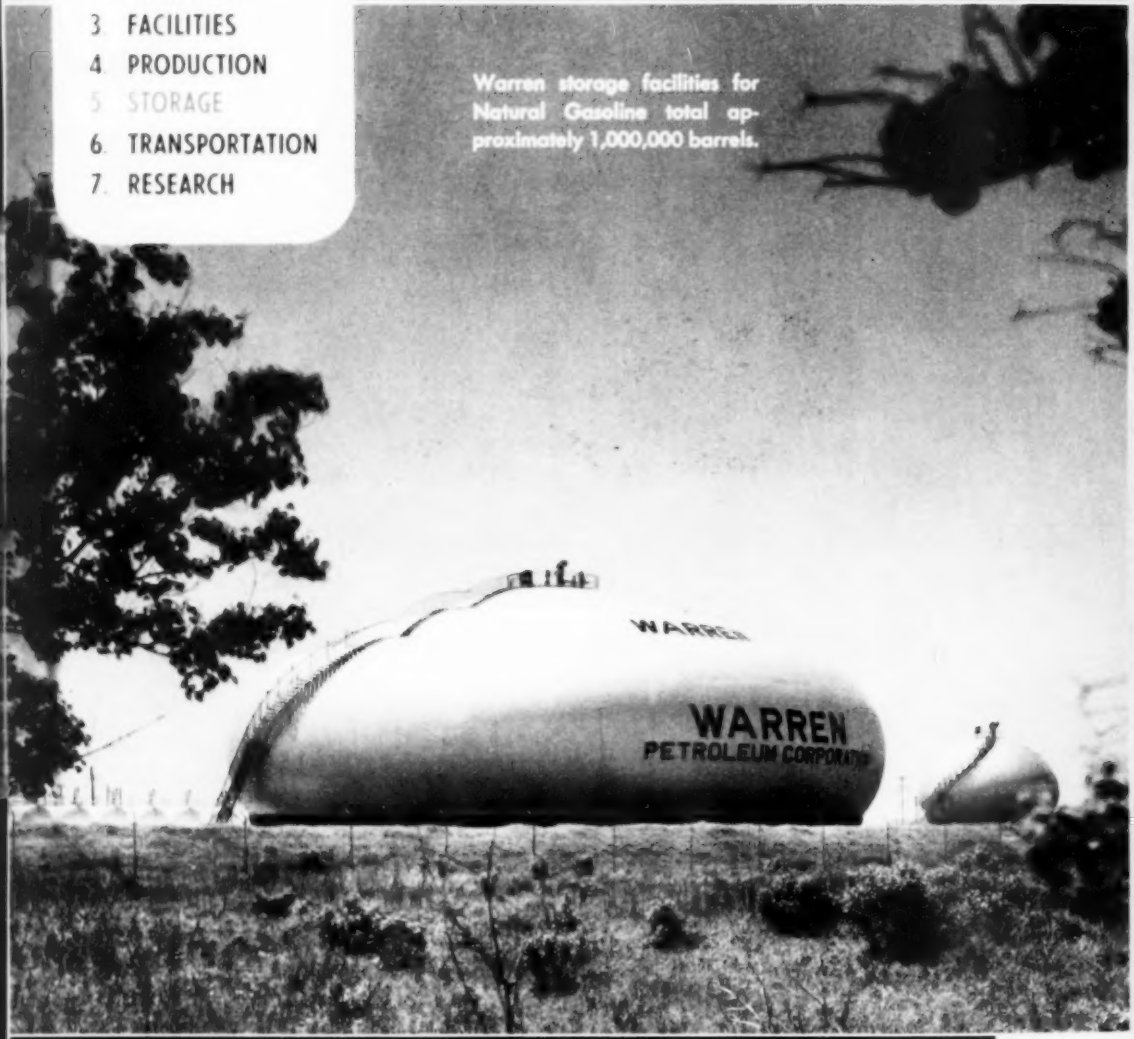
HOOKER CHEMICALS

1-1430

SODIUM SULFIDE • SODIUM SULFHYDRATE • BENZAL CHLORIDE • BENZOIC ACID • BUTYRYL CHLORIDE • LAURYL CHLORIDE • SULFURYL CHLORIDE

7 Reasons WHY IT'S WARREN

1. PERSONNEL
2. EXPERIENCE
3. FACILITIES
4. PRODUCTION
5. STORAGE
6. TRANSPORTATION
7. RESEARCH



WARREN PETROLEUM CORPORATION

Producers, Manufacturers, Exporters and Marketers

Export Terminals: Corpus Christi, Port Arthur, Baytown, Texas City, and Norsworthy, Houston, Texas.

TULSA 2, OKLAHOMA CABLE ADDRESSES: Stavolene, Warren

30 YEARS SERVI

Crude Oil, Natural Gasoline and Liquefied Petroleum Products

Company and Location	Hydrocarbon Raw Materials	Products	Remarks
Crown Central Petroleum Corp Pasadena, Tex	natural gas	ethylene, propylene	
Diamond Alkali Co Houston, Tex	ethylene	ethylene dichloride, vinyl chloride monomer, vinyl chloride polymer, perchlor ethylene	Ethylene obtained from Shell Chemical Co across the way via pipeline. Two units now under construction at an estimated $2,500,000. First unit to be completed later this year. Completion scheduled on second unit for 1953.
Dow Chemical Co Midland, Mich	ethylene, propylene (crude oil, natural gas)	styrene, butadiene, methyl styrene, ethylene glycol, ethyl benzene, ethyl chloride, ethylene dibromide, diethyl benzene, polystyrene, divinyl benzene, ethylene dichloride, dichloroethyl ether, ethylene oxide, mono-, di-, triethanolamine, ethylene diamine, i-propyl benzene, i-propyl chloride, propylene dichloride, propylene glycol, propylene oxide, i-propanolamines, vinyl chloride, toluene, polyglycols	
Dow Chemical Co Pittsburg, Calif	natural gas	methylene chloride, methyl chloride, chloroform, carbon tetrachloride, perchloroethylene	
Dow Chemical Co Freeport and Velasco, Tex	methane (natural gas) ethylene and propylene (cracking of ethane-propane mixtures), benzene	styrene, toluene, vinyl chloride, methyl and ethyl chloride, carbon tetrachloride, chloroform, perchlorethane, hexachlorethane, ethylene glycol, diethylene glycol, triethylene glycol, tetraethylene glycol, dipropylene glycol, propylene glycol, tripropylene glycol, perchlorethylene, trichlorethylene, dichlorethyl ether, d chlorisopropyl ether, ethylene oxide, propylene oxide, ethylene dichloride	
Dow Chemical Co Gardena, Calif	ethylene (propane)	styrene, ethylbenzene	
Dow Chemical Co Torrance, Calif	ethylene	styrene	
du Pont, E. I., de Nemours & Co., Inc Orange, Tex	natural gas, petroleum benzene, petroleum cyclohexane, propane, ethylene	methanol, glycols, adipic acid	Sabine River Works
du Pont, E. I., de Nemours & Co., Inc Deepwater Point, N. J	petroleum benzene, ethylene	aniline, ethylene oxide, ethyl chloride, ethylene dichloride, ethylene dibromide	Chambers Works
du Pont, E. I., de Nemours & Co., Inc Belle, W. Va	petroleum cyclohexane	nylon intermediates	
du Pont, E. I., de Nemours & Co., Inc Victoria, Tex	butadiene, natural gas	adiponitrile	
du Pont, E. I., de Nemours & Co., Inc La Porte, Tex	benzene, dimethylamine, methyl formates	dimethyl formamide, benzene hexachloride, acetic anhydride	
Esso Standard Oil Co Baton Rouge, La	refinery gases	i-propyl alcohol, ethyl alcohol, i-octyl alcohol, ethyl ether, i-propyl ether, diiso-butylene, butadiene, isoprene, dicyclopentadiene	
Esso Standard Oil Co Bayway, N. J	refinery gases	i-propyl alcohol, s-butyl alcohol, i-propyl acetate, s-butyl acetate, methyl ethyl ketone, i-propyl ether, naphthenic acids, lube oil additives	

Company and Location	Hydrocarbon Raw Materials	Products	Remarks
Ethyl Corp. Baton Rouge, La.	ethylene, kerosine, propane	amyl nitrate, ethyl chloride, ethylene dichloride	
Ethyl Corp. Houston, Tex.	ethylene, kerosine, propane	ethyl chloride, ethylene dichloride	Manufacturing plant now under construction. Estimated completion date, late 1952.
Ethyl-Dow Corp. Freeport, Tex.	ethylene	ethylene dibromide, methylene chloride, propylene dichloride, vinylidine chloride, methyl chloroform, ethylidine chloride	Subsidiary of Ethyl Corp. and Dow Chemical Co. Manufacturing plant now under construction. Still some months away from completion.
General Petroleum Corp. Torrance, Calif.	refinery wastes	ammonium sulfate	
Great Southern Chemical Co. Corpus Christi, Tex.	petroleum fractions, ethylene, natural gas	ammonia, ammonium sulfate, ethylene glycol, ethylene oxide, ethylene dichloride, butylene, butanol	Owned jointly by Pontiac Refining Co., Chicago Corp., and LaGloria Corp.
Griffin Chemical Co. Richmond, Calif.	crude petroleum, sulfonates, naphthenates	lube oil additives	
Gulf Oil Corp. Port Arthur, Tex.	refinery gases	ethylene	New ethylene unit under construction. Est. completion date, May, 1952.
Gulf Oil Corp. Port Arthur, Tex.	heptenes	octyl alcohols	New unit under construction. Est. completion date, August 1952.
Hamisch Oil Co. Long Beach, Calif.	refinery gases	ethylene glycol	
Hercules Powder Co. Delaware River Area Wilmington, Del.	cumene from benzene and propylene	phenol, acetone, para-cresol, cymene alcohol, flotation reagents	$8,000,000 investment
Hercules Powder Co. Hercules, Calif.	methane (natural gas)	anhydrous ammonia	30,000 tons yr.
Heyden Chemical Corp. Garfield, N. J.	methanol	formaldehyde, pentaerythritol	
Heyden Chemical Corp. Fords, N. J.	methanol	formaldehyde, parachlorobenzaldehyde	
Heyden Chemical Corp. Houston, Tex.	natural gas	methanol	Construction was to begin in the first quarter of 1952.
Hooker-Detrex, Inc. Ashtabula, Ohio	ethylene	trichlorethylene	
Hooker-Detrex, Inc. Tacoma, Wash.	ethylene	trichlorethylene	$337,000 DPA certificate applied for and certified.
Humble Oil & Refining Co. Baytown, Tex.	Butylene, petroleum	butadiene, aromatic and aliphatic solvents	Government-owned butadiene plant.
Jefferson Chemical Co. Port Neches, Tex.	refinery gases	ethylene glycol, diethylene glycol, ethylene oxide, ethylene dichloride, mono-, di-, and triethanolamine	Owned by American Cyanamid Co. and The Texas Co.
Kendall Refining Co. Bradford, Penna.	petroleum fractions	product information not available	
Koppers Co. Inc. Oil City, Penna.	petroleum fractions	alkylated phenols and cresols	
Koppers Co. Inc. Kobuta, Penna.	ethylene	styrene monomer, polystyrene	
Koppers Co. Inc. Port Arthur, Tex.	ethylene	ethylbenzene	New plant under construction. Still some months away from completion.
Lion Oil Co. El Dorado, Ark.	natural gas	ammonia, ammonium sulfate, ammonium nitrate	
Lubrizol Corp. Cleveland, Ohio	petroleum fractions	lube oil additives	
Lubrizol Corp. Houston, Tex.	petroleum fractions	lube oil additives	
Magnolia Petroleum Corp. Beaumont, Tex.	petroleum fractions	ethylene, organic solvents	
Mathieson Chemical Corp. Brandenburg, Doe Run, Ky.	ethane (natural gas)	ethylene glycol, ethylene oxide, ethylene dichloride, diethylene glycol	Formerly Mathieson Hydrocarbon Chemical Corp., ethylene and chemical units went into production in January 1952. some construction still in progress.
Mathieson Chemical Corp. Lake Charles, La.	methane	anhydrous ammonia	

Company and Location	Hydrocarbon Raw Materials	Products	Remarks
McCarthy Chemical Co. Houston, Tex.	methane and ethane (natural gas)	methanol, acetaldehyde, formaldehyde	Not operating
Merichem Co. Houston, Tex.	petroleum fractions	cresylic acid, petroleum waxes	Current investment $600,000
Mississippi Chemical Co. Yazoo City, Miss.	natural gas	anhydrous ammonia	120 ST/day
Monsanto Chemical Co. Texas City, Tex.	ethylene, methane, benzene	vinyl chloride, styrene monomer, acrylonitrile	Acrylonitrile plant to be operating by end of 1952
Monsanto Chemical Co. Monsanto, Ill.	refinery gases	phenol	
Monsanto Chemical Co. Avon, Calif.	refinery gases	phenol	Construction of new plant to begin mid 1952 and be completed early in 1954
National Petro-Chemicals Corp. Tuscola, Ill.	natural gas	ethylene, ethanol, ethyl chloride	Extraction plant to be completed by January, 1953; balance of the project by July, 1953; owned by National Distillers Products Corp. (60%) and Panhandle Eastern Pipeline (40%)
Natural Gas Odorizing Co. Houston, Tex.	petroleum fractions	ethyl mercaptan and other RSH compounds	
Neches Butane Products Co. Port Neches, Tex.	butylene	butadiene	Government-owned butadiene plant. Butylene obtained from Great Southern Chemical Co.
Neville Co. Neville Island, Penna.	unsaturated petroleum fractions	aromatic petroleum solvents	
Neville Co. Anaheim, Calif.	unsaturated petroleum fractions	aromatic petroleum solvents	
Oronite Chemical Co. Oak Point, La.	petroleum fractions	lube oil additives	
Pan American Refining Co. Texas City, Tex.	petroleum fractions	aromatic solvents	
Pan-Am Southern Corp. El Dorado, Ark.	propane-propylene, butane-butylene	propylene tetramer, lube oil additives	Tetramer unit to be completed June 1952. Indoil Chemical Co. will receive all or part of the petrochemical products for distribution
Phillips Chemical Co. Houston, Tex.	natural gas	anhydrous ammonia, methanol, ammonium sulfate, pyridines	Proposed petrochemical project of Alamo Chemical Co. to be added to Phillips' existing Houston plant, at estimated $38,260,000
Phillips Chemical Co. Borger, Tex.	butane (natural gas)	diisopropyl alkilate, adipic acid, butadiene	Government-owned butadiene plant
Phillips Chemical Co. Etter, Tex.	natural gas	ammonia, ammonium nitrate, ammonium sulfate	Government-owned plant. Leased by Phillips
Prichard Corp. Santa Fe Springs, Calif.	petroleum fractions	phenol, cresols, cresylic acids	
Purex Corp. South Gate, Calif.	propylene	sulfonated alkyl benzene	
Purex Corp. St. Louis, Mo.	propylene	sulfonated alkyl benzene	New plant under construction; to be completed by mid 1952
Richfield Oil Corp. Los Angeles, Calif.	petroleum fractions	ethylene	
Rohm & Haas Co. Houston, Tex.	methane (natural gas)	ethylene cyanhydrin, acetone cyanhydrin	Several millions of dollars worth of equipment still going into the plant
San Jacinto Chemical Corp. Houston, Tex.	natural gas	ammonia	70 tons/day
Sharples Chemicals, Inc. Wyandotte, Mich.	pentane, triisobutylene	amyl alcohol, amyl chloride, amyl acetate, amyl phenols, amyl naphthalenes, amyl mercaptan, tert.-dodecylmercaptan, polyethylene glycol, tert-dodecylthioether	

Company and Location	Hydrocarbon Raw Materials	Products	Remarks
Sharples-Continental Corp. Baltimore, Md.			Liquidated in 1951. Now operated under the petrochemical department of Continental Oil Co.
Shell Chemical Corp. Houston, Tex.	refinery gases	ethyl chloride, ethyl alcohol, i-propyl alcohol, glycerol, allyl chloride, allyl alcohol, sec-butanol, methyl ethyl ketone, methyl isobutyl carbinol	New facilities still under construction.
Shell Chemical Corp. Pittsburg, Calif.	natural gas	anhydrous ammonia	
Shell Chemical Corp. Dominguez, Calif.	natural gas	anhydrous ammonia	Under construction.
Shell Chemical Corp. Ventura, Calif.	refinery gases	anhydrous ammonia	Additional facilities; completion scheduled for late 1952.
Shell Chemical Corp. Martinez, Calif.		Product information not available.	
Shell Chemical Corp. Torrance, Calif.	butane	butadiene	Government-owned butadiene plant.
Sinclair Refining Co. Houston, Tex.	petroleum fractions	butadiene sulfonates	Government-owned plant 75,000 St. yr.
Sinclair Refining Co. East Chicago, Ind.	petroleum fractions	lube oil additives, cresylic acids	
Sinclair Refining Co. Marcus Hook, Penna.	refinery gases	propylene tetramer, cresylic acids	
Sinclair Refining Co. Sand Springs, Okla.	petroleum fractions	demulsifying agents	
Socony-Vacuum Oil Co. Paulsboro, N. J.	petroleum fractions	benzonitrile	
Sonneborn, L., Sons, Inc. Petrolia, Penna.	petroleum fractions	lube oil additives	
Spencer Chemical Co. Henderson, Ky.	natural gas	anhydrous ammonia	Henderson Works
Spencer Chemical Co. Calumet City, Ill.	methanol	formaldehyde	Chicago Works
Spencer Chemical Co. Pittsburg, Kan.	natural gas	anhydrous ammonia, methanol, formaldehyde, ammonium nitrate and ammonia solutions	Jayhawk Works
Spencer Chemical Co. Vicksburg, Miss.	natural gas	anhydrous ammonia and ammonia solutions	New plant now under construction.
Standard Oil Co. (Calif.) Torrance, Calif.	butane	butadiene	Government - owned butadiene plant.
Standard Oil Co. (Calif.) El Segundo, Calif.	detergent alkane, petroleum fractions	synthetic detergents, phenol	
Standard Oil Co. (Calif.) Richmond, Calif.	petroleum fractions	lube oil additives, phenol, phthalic anhydride	
Standard Oil Co. (Ind.) Wood River, Ill.	refinery gases	octyl, isooctyl, nonyl and higher alcohols	
Standard Oil Co. (Ind.) Sugar Creek, Mo.	petroleum fractions	olefin concentrate for alcohol	
Standolind Oil & Gas Co. Brownsville, Tex.	petroleum fractions	methyl ethyl ketone, acetone, acetic acid, ethanol, n-butanol, n-amyl alcohol, acetaldehyde, butyric acid, and other organic chemicals	Raw materials piped from Carthage Hydrocol. Standolind separates and recovers purified products.
Sunray Oil Corp. Corpus Christi, Tex.	petroleum fractions	propylene tetramer	Ground-breaking ceremonies for new plant took place March 1952. Estimated completion date, mid 1953.
Sunray Oil Corp. Duncan, Okla.	petroleum fractions	propylene tetramer	
Texas Eastman Corp. Longview, Tex.	ethane, propane (natural gas)	chemical intermediates, n-butyraldehyde, isobutyraldehyde, ethanol	Products to be used as raw materials at the Kingsport, Tenn. plant of Tennessee Eastman Co. for rayon, plastic and photographic materials. Division of Eastman Kodak Co.

FACT

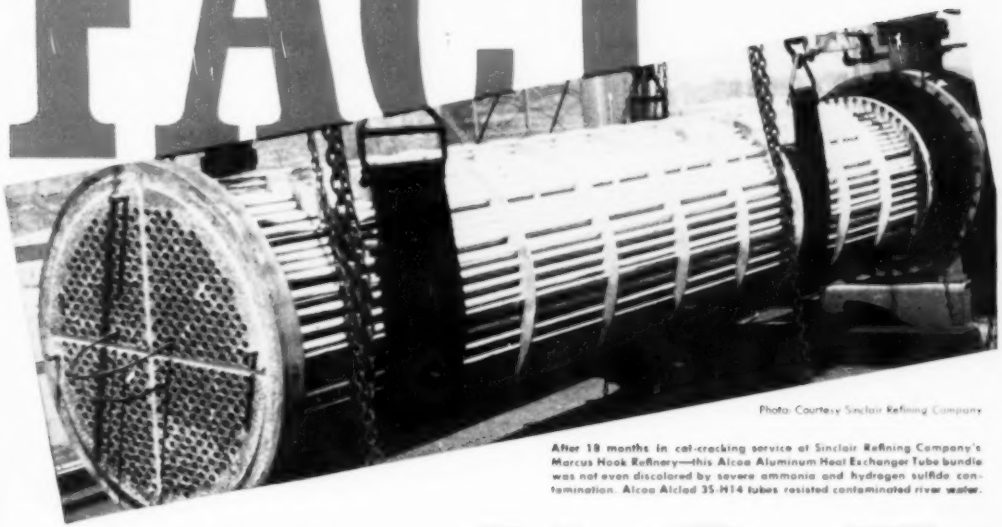


Photo: Courtesy Sinclair Refining Company

After 18 months in cat-cracking service at Sinclair Refining Company's Marcus Hook Refinery—this Alcoa Aluminum Heat Exchanger Tube bundle was not even discolored by severe ammonia and hydrogen sulfide contamination. Alcoa Alclad 3S-H14 tubes resisted contaminated river water.

ALCOA

knows most about the use and application of aluminum heat exchanger tubes

Alcoa pioneered the use of aluminum in heat exchanger tubes 43 years ago. Although their sale today is limited by government regulation, you will want to start planning with a copy of the booklet, "Alcoa Aluminum Heat Exchanger Tubes." Write:

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OVER 6-MILLION FEET OF ALCOA TUBES ARE IN USE FOR APPLICATIONS LIKE THESE . . .

PETROLEUM

Condensers handling hydrocarbon fractions from such processes as Thermal and Catalytic cracking, reforming, polymerizing, etc.
Vapor recovery condensers
Lube oil coolers
Natural gas compressor aftercoolers
Recompressor aftercoolers
Hydrogen sulfide gas coolers
Furfural condensers and heat exchangers
Propane chilling
Wax sweaters
Lean oil—rich oil exchangers
Amine solution coolers
Glycol-amine heat exchangers and reboilers
Jacket water coolers

CHEMICAL

Butanol
Ethanol
Ethylene Glycol
Glycerin
Hydroabietyl
Isopropanol
Methanol
Phenol
Propylene Glycol
Acetaldehyde
Formaldehyde
Furfural
Heptaldehyde
Acetic acid
Stearic, Palmitic, Maleic Oleic acids
Butyric acid
Naphtha
Ricinoleic acid
Acetanilide
Ammonia
Hydrogen Cyanide
Nitric acid (concentrated)
Pyridine
Hydrogen Sulfide
Benzene
Dichlorobenzene
Gelatin
Hydrogen Peroxide
Turpentine
Xylene

Use Alcoa Alclad 3S-H14 Heat Exchanger Tubes with fresh, brackish and salt-cooling waters

Company and Location	Hydrocarbon Raw Materials	Products	Remarks
Union Oil Co. of Calif. Wilmington, Calif.	refinery gases	methyl and ethyl mercaptan	
Visco Products Co. Sugar Land, Tex.	petroleum fractions	chemical additives	
Wyandotte Chemicals Corp. Wyandotte, Mich.	petroleum fractions	alkyl aryl sulfonate, synthetic detergents, sodium carboxymethycellulose	

Benzene, Toluene and Xylene Plants in the United States

Company Name Plant Location	Products	Remarks
Aromatics Refining Co. Baton Rouge, La.	Benzene Toluene Xylene	
Atlantic Refining Co. Philadelphia, Pa.	Benzene Toluene Xylene	
Atlas Processing Co. Shreveport, La.	Benzene	Estimated capacity set at 500 B/CD. Shell extractive distillation unit now under construction. Estimated completion date set for about July 1952. Investment on new construction approximately $3,500,000.
Carbide & Carbon Chemical Co. South Charleston, W. Va.	Benzene Toluene	
Continental Oil Co. Lake Charles, La.	Benzene Toluene	Gas recovery and solvent extraction unit to separate benzene and toluene now under construction.
Continental Oil Co. Ponca City, Okla.	Benzene Toluene	
Cosden Petroleum Corp. Big Spring, Tex.	Benzene Toluene Xylene	New plant under construction at an investment of $3,622,000. Est. capacities, nitration grade benzene, 100 b/d; nitration grade toluene 350 b/d; 10° xylene, 400 b/d.
Deep Rock Oil Corp. Cushing, Okla.	Benzene Toluene Xylene	Construction has not yet begun. $3,100,000 DPA at 75% certified.
Eastern States Petroleum Co., Inc. Houston, Pasadena, Tex.	Benzene	
Esso Standard Oil Co. Baton Rouge, La.	Benzene Toluene	
Great Southern Chemical Co. Corpus Christi, Tex.	Benzene Toluene	
Humble Oil & Refining Co. Baytown, Tex.	Benzene Toluene Xylene	
Pan American Refining Corp. Texas City, Tex.	Benzene Toluene Xylene	
Pure Oil Co. Toledo, Ohio	Toluene Xylene	
Republic Oil Refining Co. Texas City, Tex.	Benzene Toluene Xylene	15% Benzene Conc. 770 BCD 15% Toluene Conc. 2,480 BCD est. capacities 90% Xylene Conc. 1,030 BCD Platformer unit now being installed. Not scheduled for completion before March 1953.
Richfield Oil Corp. Los Angeles, Calif.	Benzene	
Roosevelt Oil & Refining Co. Mt. Pleasant, Mich.	Benzene Toluene	New facilities under construction. To go on stream in late fall of 1952.
Shell Oil Co. Houston, Tex.	Benzene Toluene	New facilities under construction. Will be in operation by the end of 1952. Est. capacities, benzene, 1250 b/d; toluene, 220 b/d.
Shell Oil Co. Wood River, Ill.	Benzene Toluene	New facilities under construction. Will be in operation by the end of 1952. Est. capacities, toluene, 225 b/d.
Shell Oil Co. Dominguez, Calif.	Benzene	New facilities under construction. Will be in operation by the end of 1952. Est. capacity, 50 b/d.
Sinclair Refining Co. Marcus Hook, Pa.	Xylene	
Shelly Oil Co. Longview, Tex.	Benzene	
Standard Oil Co. (Calif.) El Segundo, Calif.	Benzene Toluene	New facilities under construction. Completion expected by mid 1952.

Company Name and Plant Location	Products	Remarks
Standard Oil Co. (Calif.) Richmond, Calif.	Benzene Xylene	
Standard Oil Co. (Ind.) Whiting, Ind.	Benzene Toluene	
Sun Oil Co. Marcus Hook, Pa.	Benzene Toluene Xylene	
Taylor Refining Co. Corpus Christi, Tex.	Benzene Toluene	DPA certificate has been approved. Project is in the engineering stage at this time.
Union Oil Co. Wilmington, Calif.	Xylene	
Velsicol Corp. Marshall, Ill.	Benzene Toluene Xylene	

Sulfur Recovery Plants in the United States

Company Name and Plant Location	Sulfur Capacity, long tons yr.* Built	Building	Rumored	Source of Gas**	Remarks
Atlantic Refining Co. Philadelphia, Pa.	10*		5*	R	In operation since 1936; $3,214,000 DPA certificate of necessity issued for H_2SO_4 expansion, but no plans announced.
Cities Service Refining Corp. Lake Charles, La.	20*		40*	R	Expansion reported under consideration.
Consolidated Chem. Industries Baton Rouge, La.	30			R	Uses gas from nearby Esso refinery, put into operation in 1951.
Esso Standard Oil Co. Linden, N. J.	15*			R	See Davison Chemical Co. listing for possible expansion.
Freeport Sulfur Co. Westville, N. J.	10			R	Uses gas from adjacent Texaco refinery, in operation since 1949.
General Chemical Div., Allied Chem. & Dye Corp. El Segundo and Richmond, Calif. (2 plants)	160*		65*	R	Uses gases from refineries of Union Oil, Wilshire and California Standard; expansion reportedly to be made at El Segundo plant, to use gas from Union Oil.
General Petroleum Corp. Worland, Wyo.		50		N	Contracts not yet let, but $4,220,000 DPA certificate of necessity issued for "Sulfur and process plant;" will use gas from Manderson and Slick Creek fields.
Gulf Oil Corp. Pt. Arthur, Texas		60		R	Parsons building, completion expected this spring.
Gulf Oil Corp. Waddell, Texas		20		N	Graff building, completion expected this spring.
Hancock Chemical Co. Long Beach, Calif.	100	10		R	Uses gases from refineries of Hancock, Richfield, Texaco and General Petroleum; original plant put into operation in 1949, expanded in 1950; Parsons handling present expansion.
Humble Oil & Refining Co. Baytown, Texas				R	May supply gas to plant under consideration by Consolidated Chemical Industries.
Lion Oil Co. El Dorado, Ark.	10			N	Put into operation in 1951.
Mathieson Chemical Corp. McKamie, Ark.	100	50		N	In operation since 1944. Fluor handling expansion; plant originally built for Southern Acid and Sulfur, later acquired by Mathieson.
Mathieson Chemical Corp. Magnolia, Ark.	60			N	In operation since 1946; originally built for Southern Acid and Sulfur, later acquired by Mathieson.
Monsanto Chemical Co. Avon, Calif.		250*		R	Will use gas (and acid sludge) from Tide Water refinery.

* = sulfur equivalent of H_2SO_4 produced directly from H_2S
** R = refinery gases, N = natural gas

Company Name and Plant Location	Sulfur Capacity, long tons/yr.* Built	Building	Rumored	Source of Gas**	Remarks
Phillips Chemical Co. Crane Co., Texas		50		N	Parsons building; $510,200 DPA certificate of necessity issued.
Phillips Chemical Co. Goldsmith (Ector Co.), Texas	120			N	Put into operation Feb. 1952.
Phillips Chemical Co. Eunice, N. Mex.		100		N	DPA certificate of necessity issued for $1,498,000.
Pure Oil Co. Toledo, Ohio				R	$2,510,000 DPA certificate of necessity issued for H_2SO_4 plant.
Shamrock Oil & Gas Corp. Sunray, Texas	30			N	Put into operation in Aug. 1951.
Shell Chemical Corp. Houston (Deer Park), Texas		40		R	Parsons building; completion expected by mid-'52.
Sid Richardson Carbon Co. and Odessa Natural Gasoline Co. Odessa, Texas	20			N	Put into operation in Jan. 1952.
Sinclair Refining Co. Marcus Hook, Pa.		20		R	Parsons building.
Standard Oil Co. (Ind.) Whiting, Ind.		55		R	Fluor building; completion expected by mid-'52.
Stanolind Oil & Gas Co. Elk Basin Field, Wyo.	75			N	In operation since 1949.
Stanolind Oil & Gas Co. N. Cowden, Texas		20		N	Girdler building; completion expected early in 1953.
Stanolind Oil & Gas Co. Sundown, Texas		50		N	Fluor building; completion expected in Sept. 1952.
Stanolind Oil & Gas Co. Silvertip, Wyo.			100	N	Reportedly may build plant to process gas from Rayonier (Seaboard Oil).
Stauffer Chemical Co. Wilmington, Calif.	30*			R	Uses gas from Shell refinery.
Texas Gulf Sulfur Co. Worland, Wyo.	300			N	In operation since 1950.
Tide Water Associated Oil Co. Avon, Calif.			30	R	Reported under consideration, but may be supplying gas to Monsanto project.
Union Carbide & Carbon Co. Texas City, Texas	15*			R	Uses gas from Pan American refinery.
Union Oil Co. of Calif. Wilmington, Calif.		65		R	Reported under construction, with completion expected in Nov. '52.
Warren Petroleum Corp. Monument, N. Mex.		14		N	Reported under construction, with completion expected in spring of 1952.

* Sulfur equivalent of H_2S, produced directly from H_2S.
** R, refinery gases; N, natural gas.

Rubber Plants in the United States

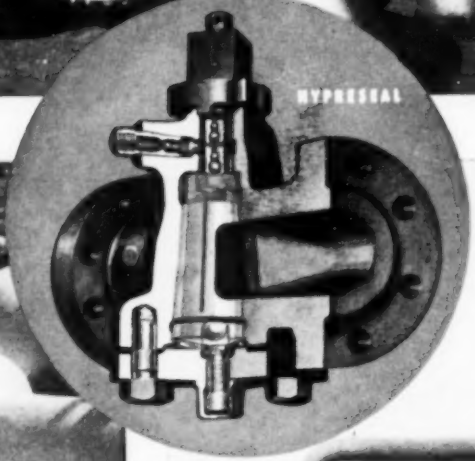
Operator and Location	Type	Capacity long tons/yr.
Copolymer Corp. Baton Rouge, La.	GR-S (cold)	37,500
Firestone Tire and Rubber Co. Akron, Ohio	GR-S	30,000
Firestone Tire and Rubber Co. Lake Charles, La.	GR-S (cold)	60,000
General Tire and Rubber Co. Baytown, Tex.	GR-S (cold)	30,000
Goodrich Chem. Co., B. F., Institute, W. Va.	GR-S	90,000
Goodrich Chem. Co., B. F. Port Neches, Tex.	GR-S (cold)	60,000
Goodyear Synthetic Rubber Co. Akron, Ohio	GR-S (½ cold; by July 1953 cold)	30,000
Goodyear Synthetic Rubber Co. Houston, Tex.	GR-S (½ cold)	60,000
Kentucky Synthetic Rubber Co. Louisville, Ky.	GR-S (converting to cold)	30,000
Midland Rubber Corp. (subsidiary of Minnesota Mining and Manufacturing Co.) Los Angeles, Calif.	GR-S (½ cold; converting ¾ cold more)	60,000
Phillips Chemical Co. Borger, Tex.	GR-S (cold)	45,000
U. S. Rubber Co. Pt. Neches, Tex.	GR-S (will convert to cold)	60,000
U. S. Rubber Co. Naugatuck, Conn.	GR-S (½ cold)	30,000
Esso Standard Oil Co. Baton Rouge, La.	Butyl (3 units)	38,000
Humble Oil & Refining Co. Baytown, Tex.	Butyl	30,000
American Petrochemical Corp. Lake Charles, La.	(not yet erected)	
Dewey and Almy Chemical Co. Cambridge, Mass.	synthetic rubber specialties	
Du Pont, E. I., de Nemours Co. Louisville, Ky.	Neoprene	75,000
Goodrich, B. F. Louisville, Ky.	Nitrile type	
Goodyear Tire and Rubber Co. Akron, Ohio	Nitrile type	
U. S. Rubber Co. Baton Rouge, La.	Nitrile type	

Nordstrom Valves

...NOW AUTOMATICALLY LUBRICATED WITH Hypermatic

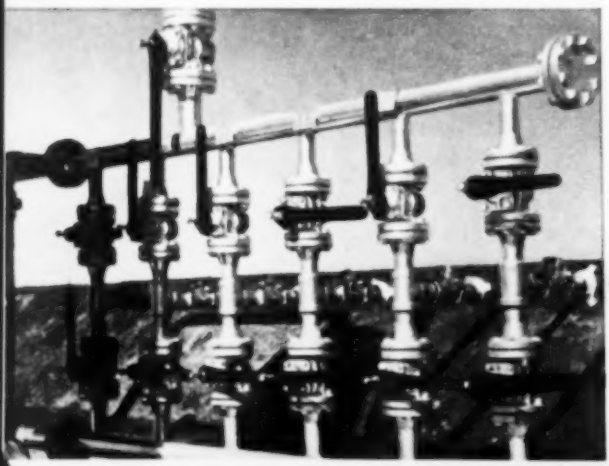
NORDSTROMS *hold the line!*

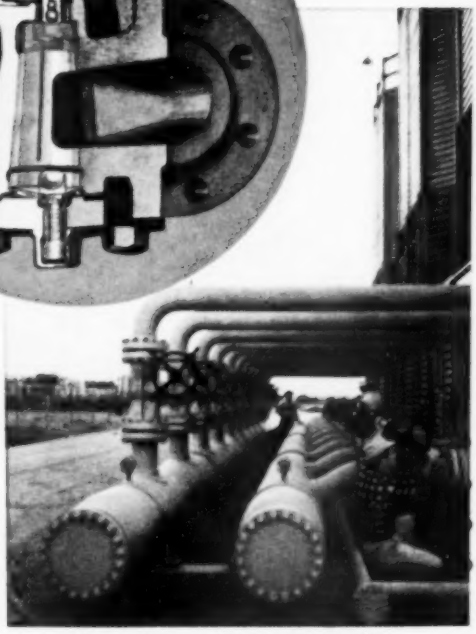
OIL PIPE LINE TERMINAL



INSULATED—HOT OR COLD

OIL FIELD MANIFOLD





COOLING TOWER HEADERS

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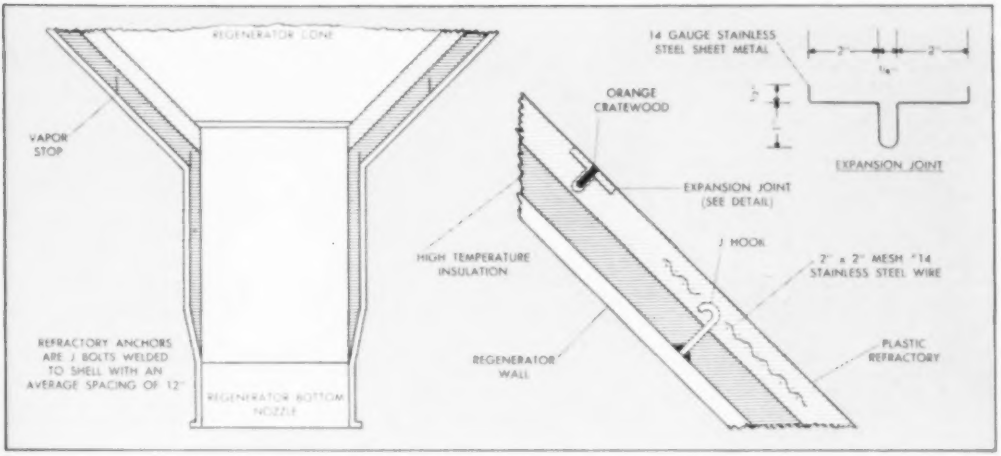

REGENERATOR CONE
VAPOR STOP
REFRACTORY ANCHORS ARE J BOLTS WELDED TO SHELL WITH AN AVERAGE SPACING OF 12"
REGENERATOR BOTTOM NOZZLE
14 GAUGE STAINLESS STEEL SHEET METAL
ORANGE CRATEWOOD
EXPANSION JOINT
EXPANSION JOINT (SEE DETAIL)
HIGH TEMPERATURE INSULATION
J HOOK
2" x 2" MESH #14 STAINLESS STEEL WIRE
REGENERATOR WALL
PLASTIC REFRACTORY

DETAILS OF EMERGENCY LINING method on a regenerator, still in service where original lining failed in one week

Emergency Lining In Use 8 Years

A QUICK repair job, consisting of replacing the entire refractory lining in the bottom cone of the Fluid catalytic cracking unit regenerator, has held up and has given good, continued service for some eight years at the Salt Lake City refinery of Utah Oil Refining Co.

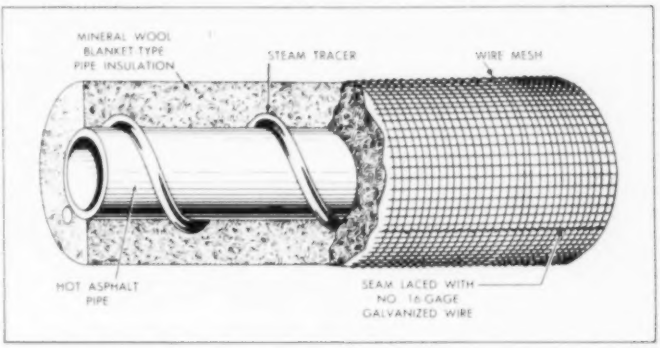
At the end of the initial 10-day trial run on the then new Fluid unit, back in 1943, refinery inspectors found that the refractory brick lining on the regenerator bottom had competely disappeared. Most of the pieces of broken tile had wound up in the catalyst return lines.

The company was anxious to get back on stream as fast as possible naturally—so instead of taking the time to re-line with block refractory, they adopted the following procedure: The previously broken tile was ground up into a kind of an aggregate and mixed with the usual standard plastic lumenite cement. This mixture was slapped back on the regenerator bottom with trowels to a thickness of 3-in., over a 3-in. layer of high temperature insulation. (See drawing).

To help hold it in place, some J-bolts were spot welded to the shell, indiscriminately spaced, but to an average spacing of about 12-in. Simple expansion joints were made as shown in the detail drawing, by folding a strip of sheet steel and using strips of orange crate wood as spacers.

The lining has never been replaced. Over 50% of it still remains today, giving good service over eight years later. Repairs have been few and not difficult. The main reason the lining has failed at all, Utoco engineers believe, is probably due to the hurried way it was laid down in the first place, with no extreme care being taken to make sure it was bonded well underneath the hooks of the J-bolts.

Insulating Traced Asphalt Piping


MINERAL WOOL BLANKET TYPE PIPE INSULATION
STEAM TRACER
WIRE MESH
HOT ASPHALT PIPE
SEAM LACED WITH NO. 16 GAGE GALVANIZED WIRE

HOW BLANKET-TYPE INSULATION is applied over spirally-traced lines

BLANKET-TYPE mineral wool can solve such troublesome installation problems as the insulation of asphalt piping heated by spirally-wrapped steam tracers.

Coiled around large-diameter asphalt lines, the steam tracers provide the necessary heat to maintain the asphalt in a proper fluid condition for easy pumping and handling. Blanket-type insulation is flexible and compressible enough to install

over the irregular contours of piping insulated in this manner.

As illustrated in the accompanying sketch, each section of blanket mineral wool is roughly shaped to fit over the pipe and its tracer. The edges of all sections are laced together tightly with 16-gage galvanized wire, with longitudinal seams located on the underside of the pipe. Exposed ends of the lacing wire are bent over into the insulation to eliminate sharp projections.

Available in two-foot lengths, the blanket sections are commonly provided with reinforcing metal lath or wire mesh on one or both sides. In the sketch, the insulation is secured with wire mesh on the outside and expanded metal lath on the inner surface. The metal lath is applied to the insulation in parallel strips to provide additional flexibility. Not shown in the sketch is that the metal lath bridges across the tracers—an effect which increases as the distance between tracer coils decreases.

The thickness of insulation depends on the operating conditions of each particular installation. Minimum thicknesses of blanket-type mineral wool pipe insulation recommended by Commercial Standard CS117-49* are given in Table I for pipe temperatures from 150 to 1200° F.

Asphalt piping located indoors may be finished with two ⅛-in. thick coats of mineral wool insulating cement. The first coat should be allowed to dry thoroughly before the second is applied. As a finish, asphalt-saturated roofing-felt, with seams lapped at least two in., is wired or banded in place on about 6-in. centers. Asphaltic finishes and canvas jackets, both applied over insulating cement, are also often specified.

In outdoor locations, piping may be finished with either roofing-felt, asphalt weatherproofing, or a sheet metal jacket. It is important that both roofing-felt and sheet metal jackets be lapped downward against the weather.

Industrial Mineral Wool Institute

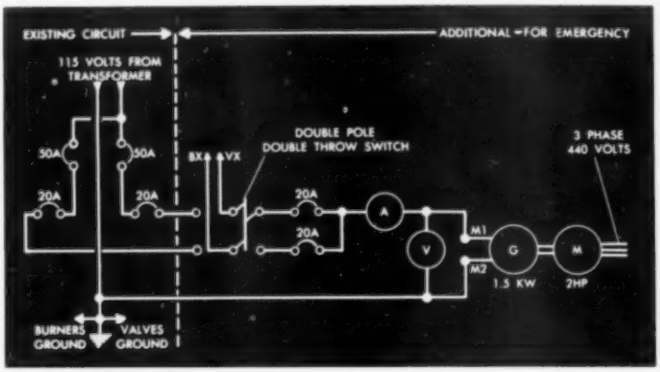
* Mineral Wool Insulation Specifications & Standards, compiled by the Industrial Mineral Wool Institute, 441 Lexington Ave., New York 17, N. Y.

Table 1—Recommended Minimum Thicknesses for Mineral Wool Blanket-type Pipe Insulation*

Temperature, °F	Thicknesses for Pipe, inches: 1 in.	2 to 4 in.	4 to 6 in.	8 in. and over
150 to 250	1	1	1	1
250 to 350	1	1	1	1
350 to 450	1	1	1	1½
450 to 500	1	1½	1½	1½
500 to 650	1½	1½	2	2
650 to 750	1½	2	2	2
750 to 900	2	2	2½	2½
900 to 1050	2	2½	3	3
1050 to 1200	2½	3	3½	4

* For safety locations when outdoors add ½ in.

Brief Power Failures No Problem



ON CONTINUOUS STANDBY OPERATION, this auxiliary motor-generator system "coasts" through short breaks in regular power supply

A simple device based on the principle of inertia helps Socony-Vacuum Oil Co.'s Casper, Wyo., refinery TCC cracking unit over "the humps" in cases of temporary, short-duration electrical failures.

The Casper plant obtains electricity for the operation of the cracking unit valves and burners from an outside power plant, and experiences frequent, very short 5 to 10 seconds power failures. A shutdown even as brief as that, puts the TCC unit safety interlock system into operation. This means immediate closure of the main valve and opening of the by-pass valve, stoppage of catalyst flow because the mechanical lift elevator stops, and cut-off of gas flow to the burners. In the event of a real emergency, this is fine. But in the case of just a short power failure it's annoying and expensive.

Socony's solution to the problem was to put in an auxiliary power source for the valves and burners 115 volt A. C. circuit, as shown in the drawing. This consists of a motor-generator set with 115 volt A. C. output. The 2 hp. motor, energized by 3-phase, 440-volt current, runs continually, turning over the 1.5 KW generator all the time. Whenever the outside power cuts off, the rotative inertia of the motor-generator is sufficient to carry on for about 15 seconds. Thus the TCC unit stays in operation during any such short power failures.

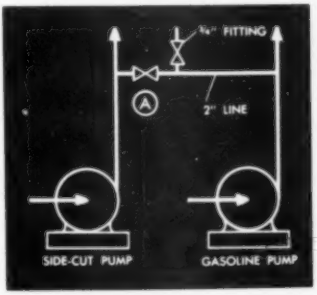
The A. C. generator is self voltage regulating because it was manufactured to operate on a fully saturated field without the use of external voltage control apparatus.

How to Seal Leaking Gate Valve

WHEN you have a leak across a gate valve that's supposed to stay tight between two different fluids, the simplest thing to do would seem to blank it off somehow with a blind flange. But sometimes if you have a unit on stream, this might require shutting down, and that costs too much.

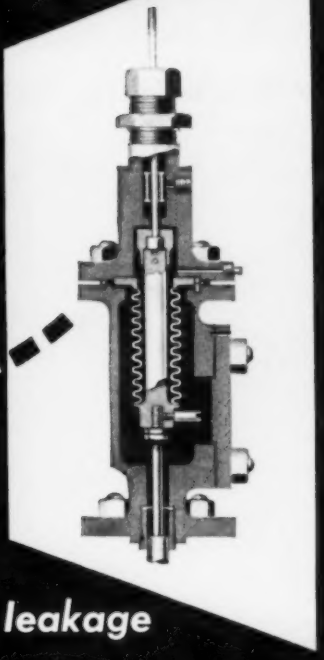
Frontier Refining Co. at its Cheyenne, Wyo., refinery was faced with this problem not so long ago on a fractionating tower. They'd had a side-cut pump and a stand-by pump along with it. That was the reason for the line across the two pump discharges with the valve A in it (see drawing).

After a while they started using the stand-by as a reflux pump for gasoline off the fractionator top. As a result, they got higher discharge pressures on the gasoline pump than on the side-cut pump, and gasoline

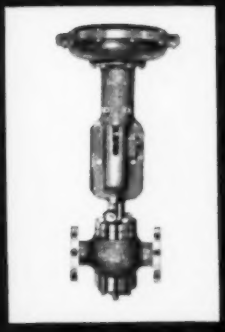


A PLASTIC "GOO" pushed in through small fitting sealed off gate valve A

POSITIVE PROTECTION . . .



prevents dangerous or costly leakage



The bellows seal of the Honeywell Series 700 Valve is a metal barrier which insures against loss of valuable or dangerous fluids . . . cannot buckle or twist . . . is precision-machined . . . takes pressures up to 600 pounds. The Honeywell Series 700 wide band proportional control valve comes in a full range of styles and sizes . . . has *all* the features you look for in a fine valve. Write today for your copy of Bulletin 700-2.

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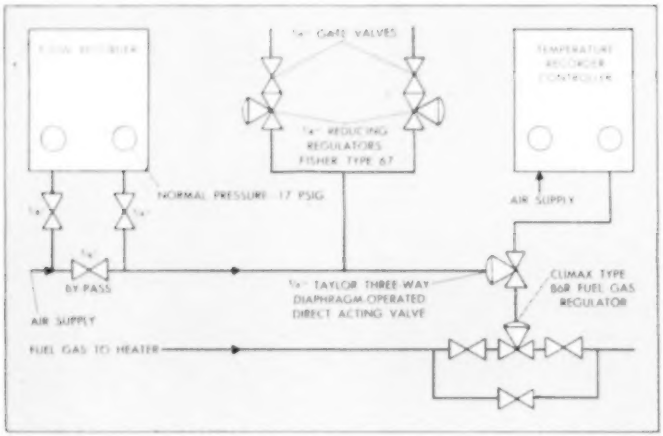
MINNEAPOLIS
Honeywell
VALVE PRODUCTS

First in Controls

began to leak through valve *A*.

The solution was to weld a ¾-in. coupling on the 2-in. cross line, on the pressure side of valve *A*. Then they put a nipple and a gate valve on the coupling and drilled through into the 2-in. line. Then they ground up some 85% magnesia block insulation and mixed it with Crane plastic packing, and pushed this "goo" into the 2-in. line through the ¾-in. fitting with a pressure gun. Discharge pressure of the gasoline pump carried the stuff against the valve gate, around the seat, etc., and sealed it off neatly. And at no time was it necessary to take the fractionator off stream.

How to Stop Fires in Oil Heaters


¾" GATE VALVES
¾" REDUCING REGULATORS FISHER TYPE 67
NORMAL PRESSURE 17 PSIG
AIR SUPPLY
BY PASS
AIR SUPPLY
¾" TAYLOR THREE WAY DIAPHRAGM OPERATED DIRECT ACTING VALVE
CLIMAX TYPE 80R FUEL GAS REGULATOR
FUEL GAS TO HEATER

AUTOMATIC MINIMUM FLOW SHUT-DOWN protects direct-fired oil heaters with this instrumentation

When oil flow through direct-fired heaters stops abruptly, excessively high pressure and temperatures are created within the oil tubes unless the fire is cut out of the fire box immediately. The hazard of rupturing tubes and a serious fire is greatly increased under these conditions. An automatic minimum flow shut-down device has been developed to protect heater tubes from such an occurrence.

The hook-up is illustrated in the accompanying drawing. The original installation on the heaters consisted of a discharge oil temperature recorder-controller, operating the heater fuel gas regulator, and a flow recorder, measuring oil flow through the heater. With these instruments already in place, it was necessary to buy only a ¾-in., three-way, diaphragm-operated, direct-acting valve, two ¾-in. reducing regulators, and an on-off control unit for the flow recorder to make up the complete automatic shut-down installation.

The three-way valve was placed in the controlled-air line between the temperature recorder-controller and the fuel gas regulator. The two reducing regulators were connected in reverse in parallel on the controlled-air line between the flow recorder and the three-way valve diaphragm. The on-off unit was installed in the flow recorder.

Operation is as follows: The index pointer on the flow recorder was set at a point slightly below normal recorded flow. As long as oil flow remains normal, full instrument air supply pressure is transmitted by the flow recorder to the three-way diaphragm valve, allowing it to stand open. Controlled-air flow from the temperature recorder-controller to the fuel gas regulator is therefore not interrupted. When oil flow stops, the indicator pen on the flow recorder drops below the index pointer and trips the flapper away from the nozzle which bleeds the air pressure from the line supplying the three-way diaphragm valve. The two ¼-in. reducing regulators (installed in reverse) are set to open to the atmosphere when line pressure drops to 10 psig. This provides additional means for venting the controlled-air from the line between flow recorder and three-way valve off to atmosphere.

As the controlled-air pressure drops below 10 psig., the three-way valve closes off the controlled-air flow from the temperature recorder-controller to the fuel gas regulator. Simultaneously, a bottom port in the three-way valve is opened and vents air from the line between this valve and the fuel gas regulator diaphragm. The fuel gas regulator then closes and fire is extinguished in the fire box.

If the oil flow is re-established to normal in a short time, the flapper again covers the nozzle and allows controlled-air to again flow toward the three-way valve. This air pressure would open the three-way valve and consequently the fuel gas regulator if allowed to build up. Since it is desirable that the heaters not be fired up until the operator desires, the air pressure is bled off from this line through the two reducing regulators to the atmosphere.

Caution must be taken to provide sufficient bleed-off capacity to prevent build-up to 10 psig. Should the pressure reach 10 psig., the reducing regulators would close and allow normal controlled-air to pass from the flow recorder to the three-way valve. Two reducing regulators are used on the installation at the plant where this device was developed.

In order to place the shut-down device back in operation after normal oil flow is resumed, the plug valve downstream of the fuel gas regulator and the one on the bypass around this regulator must be in closed position. The two ¼-in. gate valves downstream of the ¼-in. reducing regulators are closed manually by the operator. This permits controlled-air pressure to build up again and open the three-way valve, allowing the controlled-air to flow to the fuel gas regulator. Then the plug valve downstream of the regulator is opened and the heaters ignited, establishing normal service.

When it becomes necessary to reduce the oil flow to a heater by stopping one of the two pumps in this service, the automatic shut-down device must be taken out of service to prevent completely cutting off the fuel gas supply to the heater. This may be accomplished by opening the by-pass between the air supply and controlled-air lines on the flow recorder, thereby maintaining the three-way valve in open position.

The plant has had six of these mechanisms in service for approximately one year. They have proved to work perfectly on numerous occasions since their initial installation.

The preceding article is based on a prize-winning idea from the "Operating Kinks" session at the Permian Basin regional meeting of the National Gasoline Assn. of America, Odessa, Texas, February 29, 1952, and submitted by N. A. Alkesson, asst. superintendent, Shell Oil Co., Nottress, Texas.

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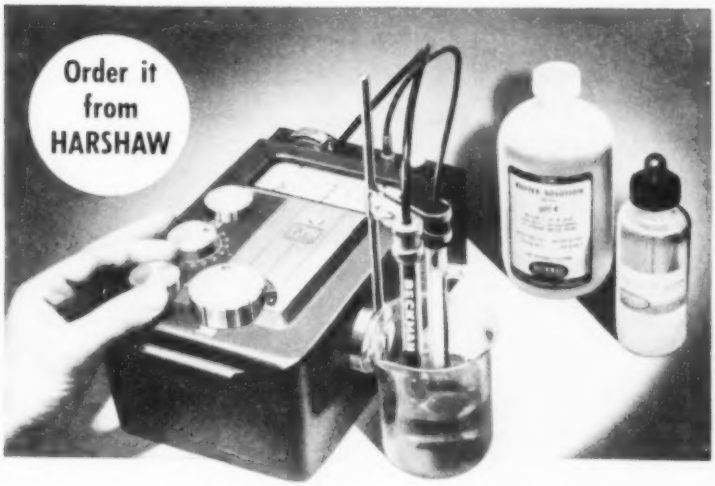

The new Beckman Model N pH Meter is entirely independent of any outside power circuit. It meets perfectly the wide demand for a completely portable battery operated pH instrument that is inexpensive, light in weight, compact, and rugged enough to be used anywhere. The newly developed Beckman Model N not only meets all these requirements, but many more. For instance, the electrode support rotates alongside the case for maximum convenience in carrying. Instrument can be used in either horizontal or vertical position. Convenient controls not only centralize all operating functions, but also permit checking amplifier circuits and battery condition without opening case or disturbing battery connections.

Two Models are Available:

1. Model N-1 (illustrated), without a cover but with a rigid handle—12 inches long, 4½ inches deep, 7½ inches wide including electrodes. Complete with glass and reference electrodes, electrode holder, 50 ml beaker, buffer solution, 100 ml KCL solution, 100 grams KCL crystals.

2. Model N-2 (not illustrated), with a cover compartment hinged to the case with spaces for 2-ounce bottles of buffer solution and distilled water, thermometer, electrodes and beaker—12 inches long, 8 inches deep, 7½ inches wide including electrodes. Complete with the same accessories as listed above for Model N-1 and in addition, thermometer, 0-100° C., polyethylene bottles for buffer solution and distilled water.

H-29601—Beckman Model N-1 pH Meter. Each **$180.00**

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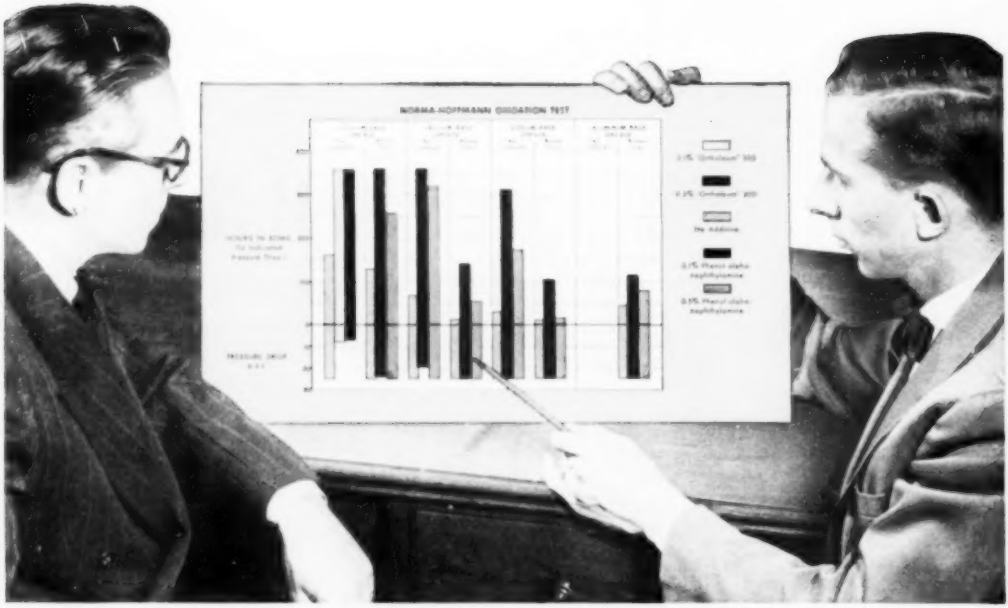

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(To obtain more data on advertised products see page 552)

By Peter J. Gaylor, Patent Attorney, Gaylor, Cifelli & Jurick, Newark, N. J.

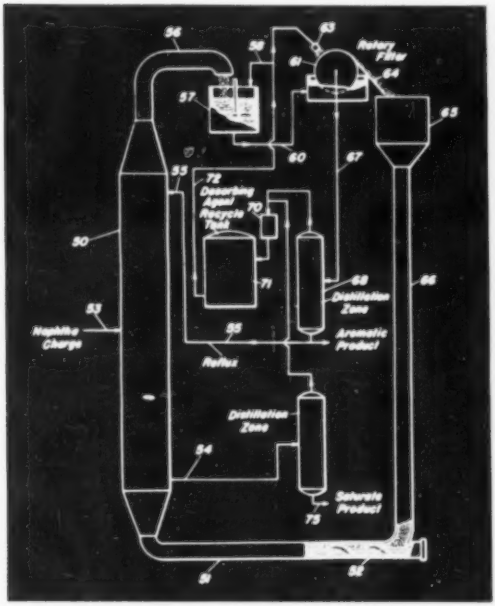

Fig. 1. Apparatus for continuous separation of hydrocarbons with selective absorbents (Sun Oil Co., U. S. 2,564,717)

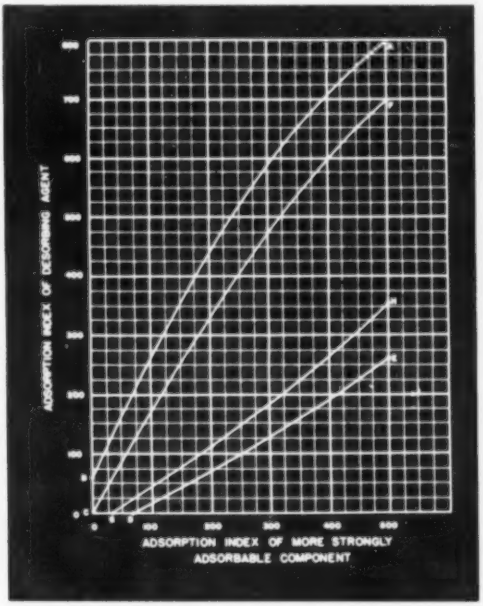

Fig. 2. Curves employed to aid in selection of proper desorbing agent (Sun Oil Co., U. S. 2,564,717)

Continuous Selective Absorption on Silica Gel

IN RECENT years, several oil companies have reported processes employing adsorbents, such as silica gel, for separating hydrocarbons, such as aromatics from non-aromatics. A continuous process employing a moving bed is described in Sun Oil Co.'s U. S. patent 2,564,717.

As can be seen from Fig. 1, the process comprises continuously introducing, by means of screw conveyor 52, adsorbent into a separation column 50 and passing it through this tower in the form of a moving bed. A stream of liquid charge material 53 is fed continuously into the moving bed at a point intermediate between the ends of the separation zone. Adsorbent (such as silica gel), containing the more adsorbable hydrocarbon (such as aromatics), is withdrawn from the opposite end 56 from which it was introduced (i.e. line 51), while the raffinate liquid containing nonadsorbed hydrocarbon (such as saturated hydrocarbons) is drawn off through line 54. Liquid reflux is continuously fed into separating column 50 via pipe 55.

The adsorbent and extract discharged into agitator 57 is contacted with liquid desorbing agent (such as benzene) fed into tank 57 through line 58. The amount of desorbing agent need be only sufficient to permit the mixture to take the form of a suspension rather than a wet mass. Contact of the benzene with the silica gel in tank 57 causes a partial displacement of the aromatics from the gel and replaces them through transfer of benzene to the adsorbed phase.

This suspension is continuously pumped from tank 57 through line 60 to a rotary vacuum filter 61, where the liquid is filtered off the gel. The filter cake is washed continuously with some benzene through nozzle 63, sufficient to completely displace aromatics from the gel, leaving only benzene in the adsorbed phase. The benzene-wetted adsorbent passes over scraper 64 into hopper 65 on top of standpipe 66 and is transferred by screw conveyor 52 to separator tower 50.

Filtrate from filter 61 flows through line 67 to distillation zone 68, where separation of benzene from the other aromatics takes place, the recovered benzene being condensed in condenser 70, while the aromatic bottoms are removed and some used as reflux through line 55.

The desorbing agent on wet adsorbent entering column 50 is displaced by hydrocarbons flowing down the column and leaves through line 54 with the liquid raffinate and is distilled off and condensed at 70 and stored in tank 71 for recycle through line 72. Saturated hydrocarbon raffinate then is drawn off as bottoms through line 75.

In determining whether an organic solvent will be suitable as desorbing agent where a particular charge mixture is to be separated in accordance with the invention, reference should be had to Fig. 2, which discloses a chart defining the upper and lower limits of adsorbability for the desorbing agent. To utilize Fig. 2 it is first necessary to know the adsorption index of the organic solvent in question and also the adsorption index of the more strongly adsorbable component

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(M) of the charge. The chart shows the maximum and minimum permissible limits of adsorption index for the solvent as a function of the adsorption index of component M and also preferred maximum and minimum values to insure more economic operation. The maximum permissible limit is defined by the lines AB and BC and the minimum by the lines CD and DE. Thus, if the point fixed by the adsorption index values for the two materials falls within the area ABCDE, the organic solvent will be operable as a desorbing agent in the process. Preferred desorbing agents, however, have an upper limit defined by the line FG and a lower limit defined by the lines CG and GH. Desorbing agents having the preferred characteristics will therefore fall within the area FCGH.

As a more specific illustration of the use of Fig. 2, assume for example that a mixture of M and L is to be separated and that M, the more adsorbable component, has an adsorption index of 160. By reference to Fig. 2, it can be seen that the desorbing agent used must have an adsorption index between about 42 and 337. It would be preferable, however, to use a solvent having an adsorption index between about 87 and 253 so as to insure efficient operation.

Adsorption indices of various organic solvents on silica gel have been determined and are of sufficient interest to be included here as Table 1.

Table 1 — Adsorption indices of various organic solvents on silica gel

Compound	Adsorption Index
[illegible]	about [illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	12
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	21
[illegible]	24
[illegible]	26
[illegible]	28
[illegible]	30
[illegible]	31
[illegible]	31
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	101
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	204
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

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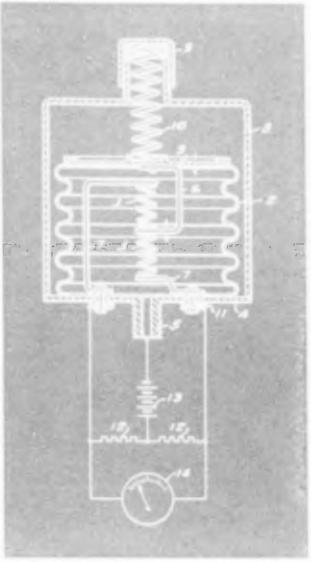
 (To obtain more data on advertised products see page 552)



Electro-mechanical Gage Measures Pressures

HIGH sensitivity can be obtained in an instrument for measuring physical variables by electro-mechanical means. The way it works in a fluid pressure indicator, for example is illustrated in the accompanying drawing.

Resistance wires 1, of nickel or other suitable material affording a temperature coefficient of resistivity, are in the form of helical springs. They are enclosed in flexible bellows 2, one end of which is sealed by plate 3 and the other by a supporting plate 4 which has a nipple 5 for connecting the inside of the bellows to the fluid system whose pressure is to be measured.

Pressure variations therefore deflect oppositely, the two wire resistors 1, because the center joint of the end-to-end connected wires is secured to plate 3 by bracket 6, and the outer ends of the wires are secured to plate 4 by brackets 7. Thus: as plate 3 moves upwardly, the upper wire 1 is compressed and the spacing of its helices is decreased. Simultaneously, the lower wire is elongated and the helices' spacing is increased.

The entire bellows is housed in a protective closure 8 with an externally-threaded tubular section projecting from the top. This section is capped and a calibrating spring 10 is placed between cap 9 and plate 3. Adjustment of the spring force by cap 9 therefore balances fluid pressure inside bellows 2 to produce the required spacing of the helices. Thus, for a given heating current in the wires 1, their resistances are made equal or brought to some relative value whereby the electrical network connected to the wires may be balanced, or at least adjusted to a predetermined degree of unbalance, depending upon requirements.

Support 6 is electrically connected to plate 3 this connection continuing to plate 4 through bellows 2. Supports 7 are insulated from plate 4. With this arrangement, wires 1 form adjacent legs of an electrical bridge circuit, the remaining two legs of which are formed by resistors 12. Battery 13, of sufficient capacity to circulate current in the bridge circuit of enough magnitude to heat wires 1 and their helices, is connected between resistors 12 and plate 4. Meter 14, which may be calibrated in pressure values with the zero position at the center, is connected across the remaining two terminals of the bridge circuit. The system is said to be practically independent of variations in source voltage over a normal working range of about ±10%.

U. S. 2,586,393, issued February 19, 1952, to R. M. Smith and G. W. Rosenberger, assignors to Westinghouse Electric Corp., East Pittsburgh, Penna.

Patents Issued in February

The following classified listing gives the patent number, patentee or assignee, and a brief description of all patents believed to be of interest to the petroleum processing industries, as contained in the Official Gazettes of the U. S. Patent Office for February 5, 12, 19, and 26, Vol. 655, Nos. 1-4.

PROCESSES

Catalysts

2,584,102 (Universal Oil Prod.) Supported phosphoric acid catalyst and its preparation.

2,584,115 (Houdry Process Corp.) Production of a catalyst from kaolin clay.

2,584,286 (Standard Oil Development Co.) Preparation and drying of catalytic material beads.

2,584,405 (Universal Oil Products Co.) Preparation of synthetic form catalysts containing alumina of magnesia.

2,585,003 (Phillips Petroleum Co.) Regeneration of a dehydrogenation catalyst.

Conversions

2,584,101 (Universal Oil Products Co.) Alkylation of aromatic hydrocarbons.

2,584,286 (Standard Oil Development Co.) Process for countercurrent contacting of solids and gases.

2,584,378 (Universal Oil Products Co.) Fluid contact of particles in hydrocarbon processing.

2,584,381 (Universal Oil Products Co.) Apparatus for effecting hydrocarbon contact between solid particles and fluid reactants.

2,584,768 (Standard Oil Development Co.) Method and apparatus for separating hydrocarbons.

2,585,236 (Universal Oil Products Co.) Method and apparatus for effecting the fluidized catalytic conversion of a reactant stream.

2,585,357 (Gulf Research & Development Co.)

SULFUR and CARBON *Analyses* in PETROLEUM PRODUCTS

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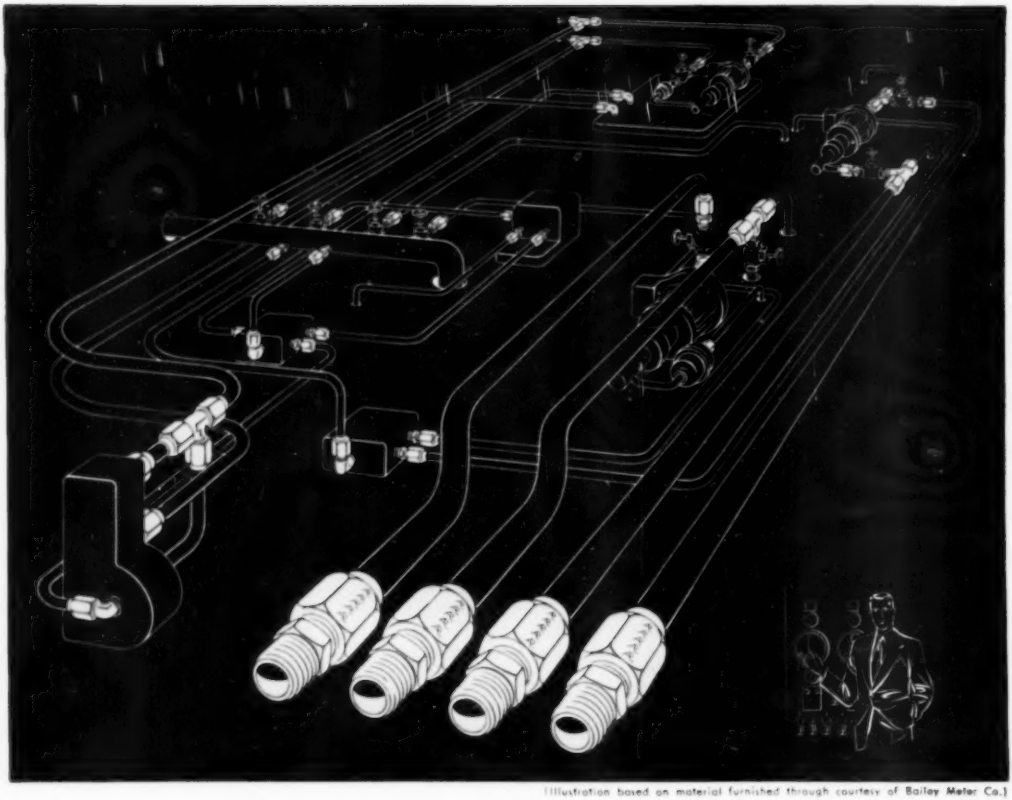
(To obtain more data on advertised products see page 552)



(Illustration based on material furnished through courtesy of Bailey Meter Co.)

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CANADA	Railway & Power Engineering Corp. Ltd. Edmonton, Hamilton, Montreal, Toronto, Vancouver, Windsor, Winnipeg

Destructive hydrogenation of hydrocarbon oils with molybdenum oxide catalyst.

2,585,231 (Standard Oil Development Co.): Catalytic reforming process.

2,585,362 (Lummus, Inc.): Process for polymerizing isobutylene using methyl chloride solution of BF$_3$ as catalyst.

2,586,026 (Shell Development Co.): Process for producing phenolic derivatives.

2,585,585 (Standard Research Corp.): Catalysts of steel and their manufacture.

2,585,962 (Standard Oil Co.-Ind.): Alkylation process.

2,586,272 (Phillips Petroleum Co.): Dehydrogenation of hydrocarbons with synthetic gel-type metal oxide catalysts.

2,586,550 (Universal Oil Products Co.): Catalytic hydrogenation of aromatic hydrocarbons in a stainless steel reactor.

2,586,704 (Standard Oil Development Co.): Means for distributing solids or gases in catalytic apparatus.

2,586,707 (Monsanto Chemical Co.): Halogenated phosphonic and phosphinic acids.

Hydrocarbon Synthesis

2,584,165 (Hydrocarbon Research, Inc.): Production of oxygen by recirculation of air mixture through the air.

2,585,581 (The Texas Co.): Process for catalyst conversion of carbon oxides.

2,586,618 (Standard Oil Development Co.): Hydrocarbon synthesis process.

Re. 23,463 (Hydrocarbon Research, Inc.): Process of producing oxygen.

2,586,911 (Hydrocarbon Research, Inc.): Process for producing oxygen.

Refining

2,584,284 (California Research Corp.): Recovery of sulfur compounds from petroleum by extracting with mineral acid followed by HF.

2,584,286 (Standard Oil Development Co.): Separation of oxygenated organic compounds from synthetic naphtha.

2,584,788 (Gas Research & Development Co.): Process and apparatus for separating gas mixtures.

2,584,961 (Shell Development Co.): Method of recovering naphthenic acids from hydrocarbon oils.

2,584,966 (Socony-Vacuum Oil Co.): Chilling of oils in dewaxing.

2,585,244 (Universal Oil Products Co.): Thermal diffusion apparatus.

2,585,284 (Standard Oil Co.-Ind.): Mercaptan extraction with methanol vapors containing alkali-alkylcarboxylic acid salt.

2,585,496-2 (Sun Oil Co.): Continuous adsorption process.

2,585,574 (Stratford Engineering Corp.): Treating lubricating distillates by deaeration, acid, etc.

2,585,585 (Sun Oil Co.): Wax refining with clay.

2,585,912 (Hydrocarbon Research, Inc.): Regeneration for the recovery of the cold content of gases.

2,585,984 (Phillips Petroleum Co.): Pebble heater apparatus and method for heat exchange.

2,586,156 (Union Oil Co. of Calif.): Refining of wax.

2,586,200 (Standard Oil Development Co.): Shale distillation.

2,586,227 (Houdry Process Corp.): Method of separating olefins from hydrocarbon mixtures with nitrogen tetroxide.

2,586,428-9 (Phillips Petroleum Co.): Separation of oxygen-containing chemical compounds.

2,586,947 (Standard Oil Co.-Ind.): Propane-clay treating.

2,587,260 (Phillips Petroleum Co.): Apparatus for molecular distillation.

2,587,564 (Standard Oil Development Co.): Apparatus for dropping finely divided solids

PRODUCTS

Chemicals

2,584,112 (Standard Oil Co.-Ind.): Organic phosphines.

2,584,278 (Socony-Vacuum Oil Co.): N-(thiophenalkyl)-arylamines.

2,584,315 (The Texas Co.): Polyester copolymers.

2,584,316 (The Texas Co.): Copolymers of diallyl endomethylene tetrahydrophthalate and an unsaturated mixed polyester.

2,584,373 (Phillips Petroleum Co.): Emulsion polymerization of vinylidene compounds in the presence of hydroperoxides of alkyltetrahydronaphthalenes.

2,585,091 (The Texas Co.): Side chain halogenation of alkyl thiophenes.

2,585,292 (Standard Oil Co.-Ind.): Preparation of alkyl thiophenes.

2,585,323 (California Research Corp.): Linear pyromellitic polyesters and their derivatives.

2,585,356 (Shell Development Co.): Permanently pliable diallyl ester copolymers and compositions of intercommingle therewith.

2,585,366 (Shell Development Co.): Stabilization of halogen-containing organic materials.

2,585,841 (United States of America): Process for producing fluoroarenes.

2,585,892 (Socony-Vacuum Oil Co.): Anion exchange resins and method of treating mineral oils.

2,585,921 (Standard Oil Development Co.): Production of aliphatic acids.

2,585,936 (Standard Oil Development Co.): Elastic and fibrous bonding composition.

2,585,938 (Standard Oil Development Co.): Metal treatment of oxo alcohols.

2,585,961 (Shell Development Co.): Esters of acrylonitrile-substituted acrylic acids.

2,586,428 (Pan American Refining Corp.): Preparation of phenol aldehyde from 3 4 6-tris-hydroxy-toluol hydrochlorid.

2,586,431 (Standard Oil Development Co.): Preparation of drying oils from distillate.

2,586,692 (Standard Oil Development Co.): Purification of alcoholic liquid.

2,586,694 (Standard Oil Development Co.): Catalytic dehydrogenation of alcohols to carbonyl compounds.

2,586,726 (Phillips Petroleum Co.): Alkaliphosphorus (thiocarbamates as vulcanization accelerators.

2,587,161 (California Research Corp.): Esters of alkanephosphonic acids.

2,587,410 (Standard Oil Development Co.): Heating of vinylidene-styrene copolymer to cause

Fuels

2,584,502 (Berg-Warner Corp.): Motor fuel containing isoparaffin oxidant and flash back suppressor.

2,585,443 (Standard Oil Development Co.): Process for inhibiting rusting by leaded fuel; sulfide scavenger by burning an ester as fuel.

2,586,666 (Standard Oil Development Co.): Leaded fuel composition containing volatile tin compound.

Lubricants

2,584,077 (Standard Oil Co. Ohio): Phosphorus sulfide reacted lubricating oil.

2,585,182 (Union Carbide and Carbon Corp.): Grease lubricant comprising lithium hydroxy stearate thickened di-2 ethylhexate ester of glycol.

2,585,321 (Socony-Vacuum Oil Co.): High-temperature lithium grease containing oxy-acid phosphorus ester.

2,585,329 (Shell Development Co.): Lubricating compositions containing highly basic metal sulfonates.

2,585,413 (Standard Oil Development Co.): Hydrocarbon oil composition containing acid anhydride antioxidant.

2,585,820 (Dow Chemical Co.): Lubricating composition containing non-volatile chlorparaffin.

2,585,972 (Standard Oil Development Co.): Synthetic lubricants having oxo radical and sulfide group.

2,585,977 (Socony-Vacuum Oil Co.): Lubricating oil composition containing antiwear ester agent.

2,586,590 (Compagnie Francaise de Raffinage): Manufacture of lubricating oils from shale oil.

2,586,600 (Standard Oil Development Co.): Pour depressants from thiesters.

2,586,693 (Standard Oil Development Co.): Lubricating grease containing arylaliphatic acid soap.

Specialties

2,584,919 (Berry Asphalt Co.): Pulverent asphaltic composition.

2,585,609 (Phillips Petroleum Co.): Recovery of carbon black from suspension in a gas.

2,585,725 (Standard Oil Development Co.): 4-Tertiary alkyl chlorphenoxyacetic acids and the use thereof as plant hormone synergists.

2,586,681 (Standard Oil Development Co.): Herbicidal compositions containing still bottoms from alcohol synthesis by the Oxo process.

2,586,706 (Standard Oil Development Co.): Method for suppressing corrosion of copper containing alloys in the presence of ammonium salts.

2,586,914 (Phillips Petroleum Co.): Colloidal sulfur.

2,587,478 (Standard Oil Development Co.): Method of production of pyrethrin concentrate from whole pyrethrum flowers.

2,587,484 (Standard Oil Development Co.): Insecticidal compositions comprising a poly

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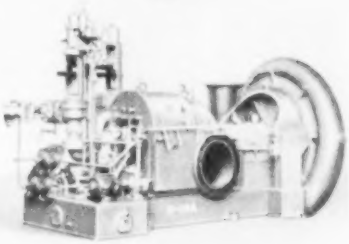

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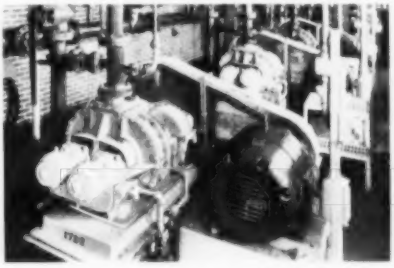

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Processing Patents

Gaskets and Seals

2,584,513 (Jet Shaft Seals, Inc.)—Sealing device for shafts on pumps.
2,584,705 (Ingersoll-Rand Co.)—Sealing device for pumps.
2,585,154 (Crane Packing Co.)—Device for rotary mechanical seals with O-rings.
2,586,739 (Linear, Inc.)—High pressure axial seal for rotating shafts.
2,586,871 (James R. Shields)—Composite pressure seal shaft packing for stuffing boxes of autoclaves and the like.
2,587,222 (Sigmund Pumps Ltd., Gateshead, England)—Shaft seal.
2,587,406 (Sealol Corp.)—Shaft seal.
2,587,408 (Allen Trask)—Shaft seal.

Pumps and Compressors

2,584,518 (George W. Walton)—Pump liner for reciprocating pumps.
2,584,565 (Economy Faucet Co.)—Positive displacement pump for fluids with suspended solids.
2,585,139 (National Research Corp.)—High vacuum diffusion pump.
2,585,406 (Lee T. Reynolds)—Solid cross vane rotary pump.
2,585,945 (Vanton Pump Co.)—Positive displacement pump of leak proof design.
2,586,502 (Ingersoll-Rand Co.)—Unloader for reciprocating compressors.
2,586,564 (Frederick Krause, Jr.)—Rotary pump.

Valves and Fittings

2,584,422 (Terrill F. Morrison)—Multiple rate valve for high pressure metering.
2,584,523 (The Beaton & Cadwell Mfg. Co., Inc.)—Pressure relief valve.
2,584,761 (Alexander S. Vuipio)—Lubricated globe valve.
2,584,847 (Reconstruction Finance Corp.)—Automatically operated valve with continuously connected hand wheel.
2,584,998 (Harry W. Evans)—Combination check and block valve.
2,585,575 (Hans C. G. R. Nedergaard, Holbaek, Denmark)—Safety valve with spring-loaded diaphragm.
2,585,667 (South Houston Machine Co.)—Valve assembly.
2,586,143 (Strong Steam Specialty Mfg. Co.)—Steam trap.
2,586,248 (Carl A. Newman and Ren S. Betts)—Thermo-safety valve.
2,586,630 (Florence Patricia Miller)—Plug valve.
2,586,691 (The Bastian-Blessing Co.)—Excess flow check valve.
2,586,900 (Chicago Forging and Mfg. Co.)—Tube fitting.
2,587,212 (Theodore Pincette)—Relief valve.
2,587,401 (Spence Engineering Co.)—Float valve.
2,587,560 (Crane Co.)—Valve body with projecting seat.

Tanks and Vessels

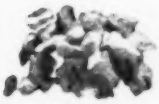
2,585,203 (John H. Wiggins)—Dry seal pressure type gas holder.
2,586,913 (Chicago Bridge & Iron Co.)—Floating roof seal.
2,586,956 (Chicago Bridge & Iron Co.)—Double-deck floating roof.
2,587,508 (Chicago Bridge & Iron Co.)—Seal hanger for floating roofs.

Miscellaneous

2,583,690 (Francis J. Carnelly)—Self-adjusting wrench.
2,585,313 (George R. Newton, Jr.)—Flange holding clamp.
2,586,105 (Phillips Petroleum Co.)—Baffle for tube assemblies.
2,586,781 (Phillips Petroleum Co.)—Line fault detector.
2,586,897 (Specialties Development Corp.)—System for dispensing fire extinguishing medium.
2,587,444 (Standard Oil Development Co.)—Fluid control system.
2,587,550 (Bell Tel. Co.)—Mass spectrometer.

How to Obtain Patents

Readers may obtain copies of any U.S. patent from the Patent Office at 25 cents each. Order by patent number direct from the Commissioner of Patents, Washington 25, D. C.



Oil and gas men know the importance of "bone dry" petroleum products. They also know that ALCOA *Activated* Alumina is one of the oldest . . . most reliable . . . thoroughly proved drying agents in the petroleum industry.

ALCOA *Activated* Alumina, earning its reputation the hard way, has *proved* its superiority, year-in, year-out, in hundreds of steady, reliable dehydration jobs. Particularly efficient in drying furnace oil and gasoline, instrument air and other gases, it has effectively solved the problems of moisture in finished products in storage or in pipe lines.

ALCOA *Activated* Alumina is highly adsorptive . . . easy to handle . . . abundantly available . . . and easily regenerated. It is one of the few desiccants that will not shatter on contact with water. It has high resistance to crushing, shock and abrasion. Moreover, this highly inert aluminum oxide dries to *lower dew points* than any other commercial adsorbent!

ALCOA *Activated* Alumina can speed up your processes . . . can save *your* money. Let us tell you how. Write to: ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 616D Gulf Building, Pittsburgh 19, Pennsylvania.

"SEE IT NOW" with Edward R. Murrow, brings the world to your armchair . . . CBS-TV every Sunday—3:30 P.M.—E.S.T.

Make the Call...

Petroleum refining and chemical manufacturing are industries of almost incredible superlatives. They have spent for new facilities since 1946 a sum roughly equal to total gross plant investment for all prior years. In these accomplishments, The Lummus Company—as design engineers and constructors—was privileged to play a major role.

But the years ahead are apt to make the past look puny by comparison. This year, for example, oil companies will top 1951 capital spending by over a third—chemical companies by nearly a fifth. Preliminary plans through 1955 show little or no relaxation from this rate.

Big job? Lummus is ready—a fact you may wish to bear in mind as mounting demands challenge the already-extended organizations of petroleum and chemical companies.

Rely on the quality and versatility of the Lummus staff—on the proven ability of Lummus to handle, under one contract, the functions of engineering, drafting, purchasing, expediting, inspecting, erection and initial operation.

And—as a policy statement for the record—rely on us to recognize and accept the special responsibility of handling confidential information in accordance with your own best interests and desires.

May we work together? We're ready!

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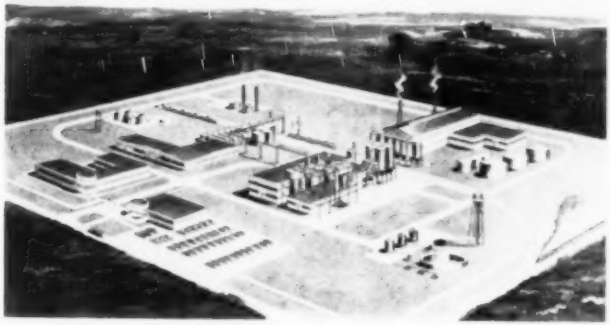

Davison Chemical Building Catalyst Plant

Artist's drawing, taken from construction plans, depicts an airplane view of the $7,000,000 plant which the Davison Chemical Corp. is building for production of petroleum cracking catalyst, and other manufacturing operations. Located 10 miles south of Lake Charles, La., on the Calcasieu River, the project encompasses a fenced area of 18 acres, total property area covering 112 acres. Day & Zimmerman of Philadelphia are architect engineers and Consolidated Engineering Co. of Baltimore are general contractors.

Refinery Supply Opens New Houston Branch

The Refinery Supply Co. of Tulsa, Okla., sister company of the Central Scientific Co. of Chicago, has opened new branch facilities in Houston, Tex. Branch address is 2215 McKinney Ave. The new structure provides about 8000 sq ft. of space for offices, stockrooms and warehouse, with adequate room for expansion.

C. L. Marner Leaves Graver

Charles L. Marner, formerly vice president in charge of sales for Graver Tank & Mfg. Co., East Chicago, Ind., has announced that he is no longer associated with the company, and although his future plans are not fully developed, he indicates that he intends to enter the consulting field. Because of his past experience in the development of vapor conservation equipment, he intends to devote his efforts to fabrication of petroleum storage facilities. Mr. Marner began his career as a salesman with the original Graver organization during the early development of the petroleum producing and refining industry.

Appointments at Blaw-Knox

Otto G. Schwenk, of Darien, Conn., has been named vice president in charge of industrial products for the Blaw-Knox Co., Pittsburgh, Pa., effective April 1st. Arthur A. Levison, formerly vice president in charge of the construction equipment department has been named vice president and general sales manager of Blaw-Knox's division. The position calls for coordination of sales and engineering functions in all departments of the division. Mr. Schwenk comes to the company from the Yale & Towne Mfg. Co. of New York, where he has been vice president in charge of production, and a director. He is an alumnus of Wesleyan University. He also did graduate work in industrial management at Harvard School of Business Administration, and industrial engineering at Western Reserve University.

H. Russell Loxterman has been appointed assistant general sales manager of the B-K division. In addition to his new duties, Mr. Loxterman will continue as manager of the steel plant equipment department.

Barber-Colman to Buy Wheelco

Barber-Colman Co. of Rockford, Ill., has announced plans to purchase the principal assets of Wheelco Instruments Co. of Chicago. Wheelco products consist of indicating, recording, and controlling industrial instruments, and combustion safeguards.

Present plans are to continue current operations in Chicago until such time as manufacturing facilities can be gradually transferred to Rockford without interruption of shipments to customers. No changes are contemplated in Wheelco's national sales and service organization. Barber-Colman has been in the automatic control field since 1926.

Byron Jackson Adds Directors

Three vice presidents named to the board of directors of Byron Jackson Co., Los Angeles, are: Lynn Sawyer, general manager of pump division; C. H. Nazro, in charge of production; F. C. Merritt, general manager of oil tool division. They filled two vacancies and a newly created directorate, increasing the number from seven to eight.

Institute Elects Officers

At the annual meeting of the Hydraulic Institute at Absecon, N. J., J. N. McComb, controller, Goulds Pumps, Seneca Falls, N. Y. was elected president. Britton L. Gordon, president, Blackmer Pump Co. of Grand Rapids, Mich., was elected vice president of the Institute.

Because of the importance of the problem water hammer to the pump industry, one entire session of the meeting was devoted to this subject. Mr. S. Logan Kerr, consulting engineer and authority on water hammer,

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BIG LINE OF METAL HOSE
Every type
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UMH Interlocked High Pressure Hose

engineered for efficiency in conveying oil, asphalt, hot tar and steam. Special tank car unloading assemblies available.

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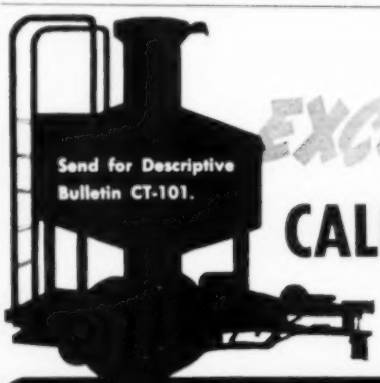

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CALIBRATING TANKS

Experience of REPETITION with hundreds of units has given us the "know-how" necessary to fabricate these REAL PRECISION INSTRUMENTS. Building, calibrating and guaranteeing a calibrating tank is specialized, painstaking work and is definitely "out" of the price-per-pound category.

All EXCEL-SO Calibrating Tanks are "Guaranteed Satisfactory," are designed to conform to the A.P.I. tentative code #1101, but may be furnished with such modifications as you, the customer, may require.

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News of Suppliers

presented a paper and conducted a discussion period on the subject. He reviewed former concepts and explained their weaknesses as compared with the more modern methods recently developed. Part of this developmental work was done by Committees of the American Society of Mechanical Engineers.

Chiksan Has New President

H. J. Hagn has been elected president and a director of Chiksan Co., Brea, Calif., and W. Edgar Spear, former president, has been advanced to chairman of the board.

J. H. Robinson has been elected a vice president of the company, and appointed general manager of Well Equipment Mfg. Corp., a division of Chiksan.

Mr. Hagn

Mr. Robinson

Mr. Hagn has been vice president and general manager of Well Equipment Mfg. Corp. in Houston, Tex., since 1946. During his tenure as vice president, the division has experienced a period of rapid growth. He joined this Chiksan division in 1937 and became head of the accounting department and subsequently, secretary and treasurer.

In one of his first directives, he has named Gus M. Bagnard as chief engineer of the company. Mr. Bagnard formerly headed the engineering department's newly-created design and development division, which is part of the company's program aimed at improving existing products.

Mr. Robinson became secretary and treasurer of the Well Equipment division in 1946. As general manager, he will continue to maintain his headquarters in Houston. He is a member and past director of the Houston Chapter of NACA.

Diffraction School Scheduled

North American Philips Co. Inc. will hold its twelfth X-ray Diffraction School at the company's plant, 750 So. Fulton Ave., Mt. Vernon, N. Y., from April 21 through April 25th. Basic subjects that will be covered include X-ray diffraction, new high and low temperature camera techniques, fluorescence analysis, Geiger-counter X-ray spectrometer, electron

(To obtain more data on advertised products see page 552)

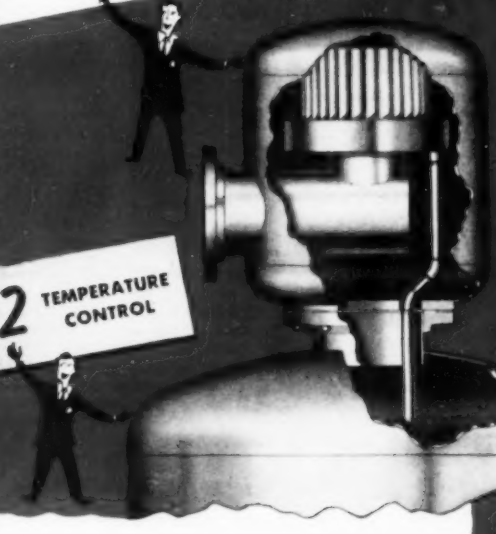
What are you doing about the third control?

3 ENTRAINMENT CONTROL

2 TEMPERATURE CONTROL

1 PRESSURE CONTROL

- STEAM DRUMS
- FLASH TANKS
- EVAPORATORS
- PACKED TOWERS
- DEODORIZERS
- STILLS
- BUBBLE-CAP TOWERS
- RECEIVERS



TYPE ID PURIFIER INSTALLED IN EVAPORATOR

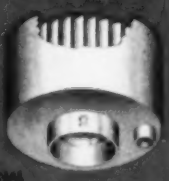
• Frequently you give serious thought and attention to *pressure* and *temperature control*. This is quite natural because it means better operation and more production and often prevents damage. But what about the *third control—entrainment control*. Lack of this control can be just as costly as lack of pressure and temperature control.

Lack of the third control can mean shut downs and loss of production due to entrainment wear in engines and process equipment. Larger slugs of entrainment have been known to blow off cylinder heads of reciprocating engines and to ruin thrust bearings of turbines.

Lack of third control means poor efficiency of superheaters, steam ejectors, dryers and other equipment. It means dirty pipe lines and fouled valves.

End this damage *once and for all* with Hi-eF Purifiers. They remove 99% of all entrainment. Individually guaranteed, Hi-eF Purifiers are the most economical protection you can buy . . . they cost no more than an ordinary separator. Write us today about your entrainment problem. Let our engineering staff, without the slightest obligation, give you the proper solution.

ANDERSON Hi-eF PURIFIERS



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PURIFIER DIVISION,

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Gentlemen: Please send additional information on Anderson Hi-eF Purifiers.

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provide air to the specific needs of many important industries because Standardaire Blowers are unique in design and construction—unequalled in quality and performance.

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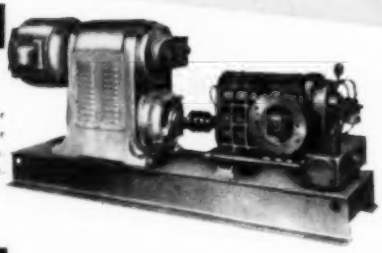
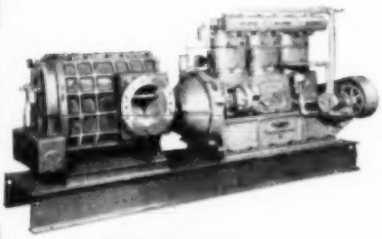


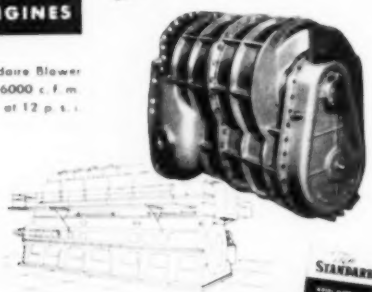
Standardaire Blower with Varidrive Motor to deliver 780 c.f.m. at 1750 r.p.m.

for SEWAGE PLANTS



Standardaire Blower with Climax Engine using sewage gas—to deliver 2100 c.f.m. at 720 r.p.m.

for DIESEL ENGINES



Standardaire Blower with 6000 c.f.m. capacity at 12 p.s.i.

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microscopy and electron diffraction.

The sessions will involve extensive classroom and laboratory work, and ample opportunity will be provided for participants to discuss their own problems and to become familiar with actual use of all types of equipment. Those interested are asked to register with the company as soon as possible.

Form Lab Specialty Firm

Mr. Newman

Labline Inc. has been formed by Laboratory Industries, Inc. of Chicago, Ill., and Alexander I. Newman, formerly executive vice president of Precision Scientific Co. The firm will manufacture laboratory apparatus, instruments, and equipment. Arrangements are now being completed for enlarged manufacturing, research and development facilities.

In his capacity as president of the new corporation, Mr. Newman will devote special attention to new laboratory instrumentation in addition to his administrative duties.

Instrument Course Offered

The Fischer & Porter Co. will hold its next instrumentation course at its Hatboro, Pa., plant from May 12 through May 16. The course will cover manufacture, calibration, installation, operation and maintenance of primary and secondary process control instruments. Users of company line instruments, who will find the course particularly useful, are invited to attend.

Orbit Valve Makes Changes

R. G. Cole, Gulf Coast district manager for the Orbit Valve Co. at Houston, Tex., has been promoted to sales manager of the company, with headquarters in Tulsa. He has been associated with the company since 1941.

Orbit has included Dallas and Fort Worth in the territory of Peter P. Kizis, field representative in the North Texas area. Mr. Kizis now headquarters at Wichita Falls, Tex.

Promotions Made In Top Echelon

Wyatt Metal & Boiler Works of Houston and Dallas have recently made five appointments at the executive level of the organization. Included are: Ralph W. Malone, to general counsel as well as vice president; John A. Wilson, to vice president;

Roy E. Hall, with the company since 1929, when he began as a machinist and draftsman, to a vice presidency; Ed C. Jones, with the company since 1923, serving originally as a field superintendent and later in charge of the building of the Houston shops, also to a vice presidency; and Jack C. Roberts, to assistant manager of sales.

Permutit Names Research Head

Mr. Gilwood

Martin E. Gilwood has been named director of research for the Permutit Co. with offices in New York City. His responsibilities include direction of the company's research, analytical, and pilot plant laboratories at Birmingham, N. J., and its market research activities in the New York office.

A graduate chemical engineer from Rensselaer Polytechnic Institute, Mr. Gilwood assumes his new office having risen in successive steps from the positions of research engineer, to assistant manager of research, to manager of chemical research.

Roots-Connersville Consolidated

Roots-Connersville Blower Corp. was absorbed into the corporate structure of its parent, Dresser Industries, Inc., Dallas, Tex., on March 31st. The company now operates under the name, Roots-Connersville Blower, a Division of Dresser Industries, Inc. The division will continue to operate as a separate, completely integrated organization at the same address, with identical plant and management as heretofore. Robert H. Owens has been appointed as president of the division, and Ralph Newquist, executive vice president.

Personnel Changes

Consolidated Engrg. Corp.—Dr. Clifford E. Berry to assistant director of research. He is a nationally known authority in the field of mass spectrometry.

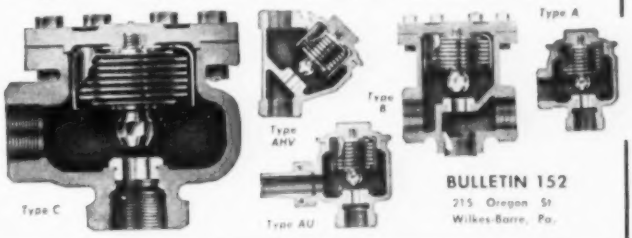
Davison Chemical Corp.—Dr. Ambrose G. Whitney to research and development department as a development engineer. He was formerly with Armour & Co. in Chicago.

Atlantic Refining Co.—Clyde P. Mumma appointed manager of the Eastern Pennsylvania marketing region, headquartered at the company's

Nicholson Traps Help

CUT STEAM COST $500,000 A YEAR

At one of the nation's large processing plants a campaign to promote economical steam use by improving heat transfer efficiency has resulted in a yearly saving of $500,000. Credit for a fair portion of this is given to improved steam trapping, which resulted from the installation of Nicholson thermostatic traps. To see why an increasing number of leading plants are standardizing on Nicholsons for positive drainage and faster heat transfer, send for Bulletin 152.



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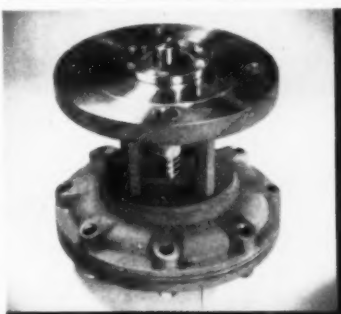
W. H. NICHOLSON & CO.

TRAPS · VALVES · FLOATS



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. . . by using the CONO PNEUMATIC PRESSURE TRANSMITTER. Bolts directly to the tank. Operates through diaphragm or bellows using force-balance principle. Ideal for service involving viscous substances or materials that solidify in conventional measuring elements. For pressure transmission, liquid level in open tanks, bulk material storage bins, etc. Write today for BULLETIN P-2520.

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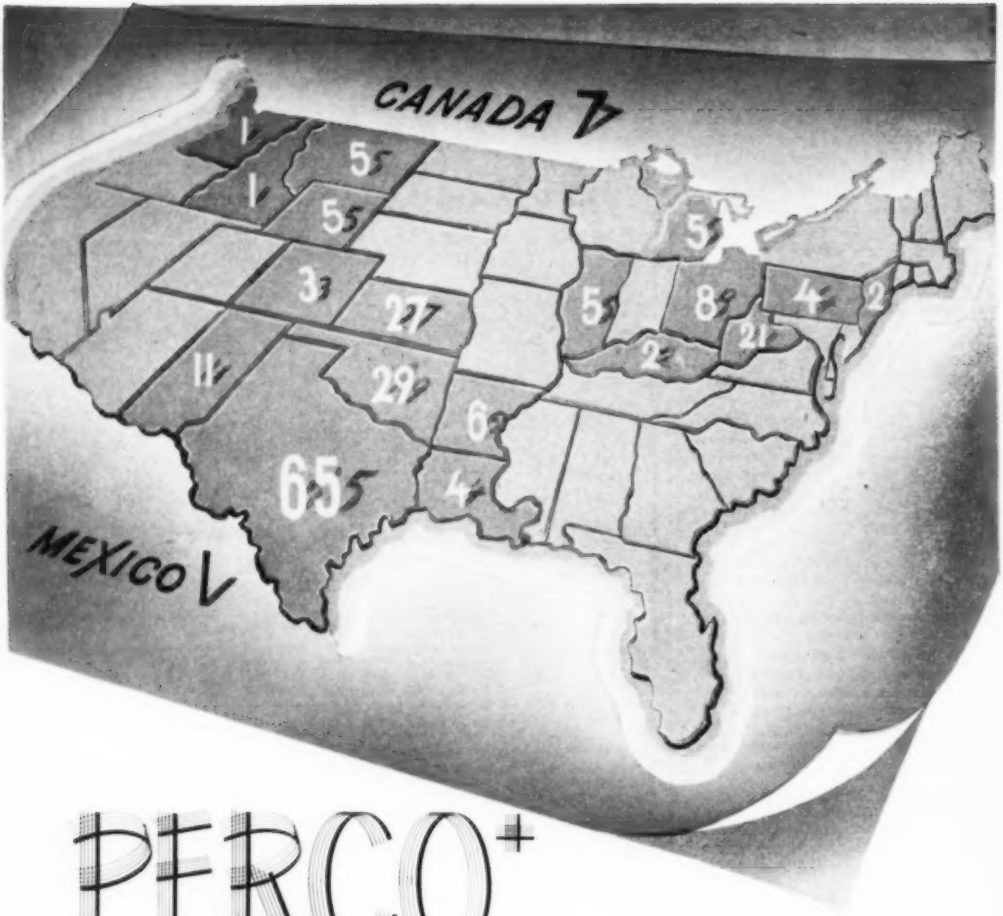
Cono-Controls

(To obtain more data on advertised products see page 552)



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COPPER SWEETENING IN NORTH AMERICA

212 Perco Copper Sweetening units with a total design capacity of well over 350,000 barrels per day are now operating or under construction.

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PERCO DIVISION • BARTLESVILLE, OKLAHOMA

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ORBIT® VALVES

ORBIT forged steel LP-Gas VALVES Provide these Performance Advantages

Adjustable Plastic Stem Packing that is impervious to Petroleum Hydrocarbons and can be repacked if necessary in an open or closed position while in service.

The use of Orbit Valves is your insurance against fluid contamination.

A seating principle that cannot freeze and needs no lubricant to effect a seal.

The valve that is designed to handle your hard to hold Hydrocarbons and vapors which you can buy with confidence.

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ODESSA, TEXAS
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ORBIT VALVE CO.

P. O. BOX 699 TULSA, OKLA.

107,000 Bbls. OIL WASTE WATER TREATED DAILY BY SINGLE HARDINGE CLARIFIER

TOTAL COST—½ MILL PER BBL.

This 57' x 150' Hardinge Rectangular Clarifier is treating 107,000 barrels of waste water daily—removing the floating oil and solids at a total operating cost of one-half mill per barrel, or 0.0012 cents per gallon. Approximately 50 barrels of oil per day are recovered.

The influent contains 3 to 5 milliliters per liter while the effluent tests show two-tenths to four-tenths milliliters per liter. Waste is treated with 25 to 45 p.p.m. aluminum sulphate and 5 to 9 p.p.m. activated silica.

Operating costs include labor, chemicals, repair, maintenance, taxes and utilities.

This is but one of the many installations where Hardinge equipment is playing an important part in the ever-growing waste treatment picture. Write us about your waste treatment problem today.

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News of Suppliers

Reading offices. He succeeds W. J. Griffiths, who is on an extended leave of absence. Prior to this appointment, Mr. Mumma served as special merchandising assistant at the Philadelphia offices.

Milton G. Davis, sales group manager of Atlantic's New England marketing region, has been appointed manager of the Southern marketing region, with headquarters in Charlotte, N. C.

Kinney Manufacturing Co.—Fred K. James from Chicago to Cleveland as branch manager. Offices in Cleveland are located at 2036 E. 22nd St. He served as a salesman to the southwest states out of the Chicago office.

E. I. DuPont De Nemours & Co., Petroleum Chemicals Division, announced the location of new headquarters for their Gulf Coast office, Suite 705-709 Bank of Commerce Bldg., Houston 2, Tex. There is no change in the address of the laboratory or warehouse.

Emil Greiner Co.—Dr. Roger Gilmont, technical and research director, has been appointed Adjunct Professor of chemical engineering at Polytechnic Institute of Brooklyn.

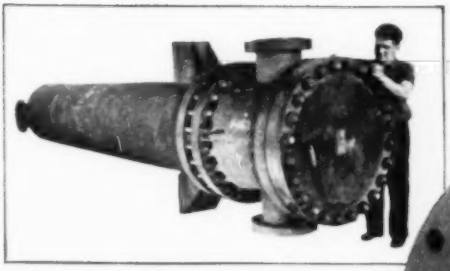
Chicago Bridge & Iron Co.—Fred L. Goldsby transferred to the export department at 165 Broadway, New York, N. Y. He has been in charge of their foreign erection department at New York since September, 1947.

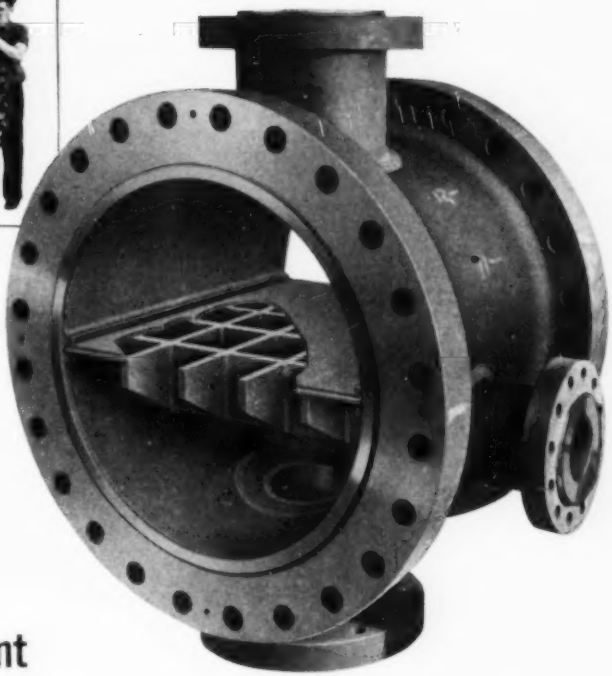
Tennessee Eastman Co.—Dr. Fred R. Conklin to works manager. Herbert G. Stone, formerly vice president and works manager, will continue as vice president of the company.

Cooper-Bessemer Corp.—Roy W. P. Johnson to the sales engineering department in New York, as a consultant to engineering firms in regard to petroleum processes and allied refining projects.

Ethyl Corp.—Marshall Sittig, technical writer, and Patricia Lynn Brown, literature searcher, have joined the information division of the research laboratories at Detroit.

Babcock & Wilcox Co.—Adin B. Capron has been named to the newly created post of chief engineer of the Tubular Products division. Mr. Capron's headquarters will be at Beaver Falls, Pa., and he will direct the activities of the drafting, engineering development, maintenance, combustion and methods engineering groups and be in charge of all plant construction.





built for one of the world's largest Ethanol plants, showing copper-lined channel and removable copper pass rib with unusual reinforcement designed to give support against high pressure drop at elevated temperatures.

How A.O.Smith protected heat transfer equipment from the effects of Phosphoric Acid Corrosion and Hydrogen Diffusion

The problem was solved for Stone & Webster Engineering Corporation of Boston, engineers and designers of the Chemical Project of the British Petroleum Chemicals, Ltd., at Grangemouth, Scotland, with this deoxidized copper-lined, high-level reactor exchanger.

Our metallurgical laboratories ran tests on various materials in collaboration with Stone & Webster Engineering Corporation and Shell Development Company, the process licensor, which aided them in establishing deoxidized copper as the most suitable material for the protective lining.

Our welding laboratories then determined procedures to be used in the shop for welding copper to copper, copper to steel, and silver-soldering copper to steel.

Combining all laboratory assistance with the experience of the A.O. Smith heat transfer and mechanical design groups made production of this unit possible.

A.O. Smith has been retained as consultants on today's most complex heat transfer problems and the facilities employed in solving them are available to you.

INDUSTRY COMES TO A.O.SMITH WITH HEAT EXCHANGER PROBLEMS

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API's Refining Division Meeting Has Industrial Communications Theme

TEN technical group sessions and an open dinner meeting are on the four-day program of the 17th mid-year meeting of the Division of Refining of the American Petroleum Institute. The meeting will be held in San Francisco at the St. Francis Hotel, May 12-15 inclusive. The central theme will be on industrial communications, and at least three papers will be presented in a session being built around the subject. Among the subjects to be covered are analytical research, electrical equipment, corrosion, industrial communications, automotive fuels, production and recovery of aromatics, and atmospheric pollution. W. M. Holaday, director of the Socony-Vacuum Laboratories, is program chairman.

A full day is being devoted to the production and recovery of aromatic hydrocarbons. Although the papers to be presented will be extremely technical, the end results of the discussions should be of immense importance to the emerging petrochemical industry. Atmospheric pollution also will receive considerable attention on the final day of the meeting. Four papers are to be presented on this subject.

It is hoped that everyone attending the meeting will come to the dinner session. The cost of the ticket will be $7.00 per person, and all those expecting to attend are urged to make their reservations promptly. The program is as follows:

Monday, May 12, 9:00 a.m.

ANALYTICAL RESEARCH: Four papers including "Micro Flash-Point Determination on Petroleum Products," Philip McCutchan and D. A. Young, Union Oil Co. of Calif.; "Determination of Nitrogen in Petroleum and Shale Oil," Subcommittee on nitrogen determination, committee on analytical research, API. (Six more papers to be presented at afternoon session at 2:00 p.m.)

Monday, May 12, 2:00 p.m.

ELECTRICAL EQUIPMENT: "Better Power-System Performance Through Better Protection," D. L. Beeman, General Electric Co.; "Thermo-Plastic Insulated Wire and Cable," W. J. Delehanty, General Electric Co.

Tuesday, May 13, 9:00 a.m.

CORROSION: Five papers including "Economics of Metals and Coatings to Combat Corrosion of Refinery Tank Roofs," H. F. McConomy and J. F. Hur, The Atlantic Refining Co.; "Internal and External Protection of Storage Tanks," J. S. Cook, Humble Oil and Refining Co.; "Corrosion of Refinery Equipment by Sulfuric Acid and Sulfuric-Acid Sludges," R. J. Hafsten, Standard Oil Co. (Ind.).

Tuesday, May 13, 10:00 a.m.

ELECTRICAL EQUIPMENT: Two papers, "Mineral Insulated-Metal Sheath Wiring: A Review of Its Characteristics and Application," W. C. Warr, General Cable Corp.; "Safety Aspects of the National Electrical Code," Frank Short, Western Oil & Gas Assn.

Tuesday, May 13, 2:00 p.m.

TRAINING: Three papers on the subject of "Communications in an Industrial Organization," and a Safety Minute man, "Fire-Protection Training," J. E. Hill, Union Oil Co. of Calif.

AUTOMOTIVE FUELS: (Sponsored by Automotive Research Committee) T. B. Rendel, Shell Oil Co., presiding.

"Engine Variables Affecting Octane-Number Requirement," H. A. Bailey, Phillips Petroleum Co.; A. E. Cleveland, Ford Motor Co.; G. E. Quinn, Studebaker Corp.

Wednesday, May 14, 9:00 a.m.

PRODUCTION OF AROMATICS: Five papers including "Three Years of Commercial Platforming," Vincent Haensel, H. W. Grote, P. C. Weinert, M. J. Sterba, Universal Oil Products Co.; "Hydroforming at Low Pressures," J. C. Hunt, A. G. Oblad, J. W. Schall, Houdry Process Corp.; "Thermofor Catalytic Reforming (TCR)," J. W. Payne, L. F. Evans, Socony-Vacuum Laboratories, and E. V. Bergstrom, V. O. Bowles, Socony-Vacuum Oil Co.

Wednesday, May 14, 2:00 p.m.

RECOVERY OF AROMATICS: Four papers including "The Absorb Price's in Refinery Operations," W. H. Davis, E. R. Weatherly, J. T. Harper, Sun Oil Co.; "A Proven Process for Recovery of High-Purity Aromatics," C. L. Dixon, G. E. Lindholm, Shell Development Co.; "Production of High-Purity Aromatics for Chemicals," Davis Read, Universal Oil Products Co.

Wednesday, May 14, 7:00 p.m.

OPEN DINNER SESSION: W. L. Stewart, Jr., vice president for Refining (American Petroleum Institute), presiding. Colonel Ball Resler, Ampex Corp., to L. A. DuBridge, president, California Institute of Technology.

Thursday, May 15, 9:00 a.m.

ATMOSPHERIC POLLUTION: Four papers including "A Paper on Waste-Gas Disposal," Aurora Gasoline Co.; "Disposal of Radioactive Wastes," J. W. McCaslin, Phillips Petroleum Co.

NPA Program Lists Talk On Synthetic Fuels

THE economics of synthetic liquid fuels production as derived from coal and oil shale will be discussed by L. C. Kemp, director of research, The Texas Co., at the 49th semi-annual meeting of the National Petroleum Assn. The meeting is to be held at the Hotel Cleveland, Cleveland, O., April 16-18 inclusive. His talk is scheduled for the general session, Thursday afternoon, April 17th.

At the Thursday morning meeting, April 17, the Department of Industrial Relations will hold a round-table meeting to discuss the current labor disputes, which the president has referred to the Wage Stabilization Board. Donald C. O'Hara, NPA attorney, will preside.

Friday morning, April 18, features three talks on Manufacture and Standards and Tests. They are *Determination of Engine Wear by Radioactive Tracers*, Dr. J. C. Geniesse, Atlantic Refining Co.; *Fuel Deposits and Spark Plug Fouling*, T. B. Rendel, Shell Oil Co.; and *Fluid Cracking Catalysts*, C. O. Brown, American Cyanamid Co. E. H. Fallin, NPA staff, will preside.

Oil and Chemical Men To Discuss Waste Problems

APPROXIMATELY fifty papers will be presented on subjects dealing with industrial wastes and their treatment at the 7th Purdue Industrial Waste Conference to be held May 7-9 in the Purdue Memorial Union Building, Lafayette, Ind. Registration is open to anyone interested in waste disposal. Included among the topics to be presented are: Talk and film on *Waste Disposal for the Dow Chemical Co.* by T. J. Powers, scheduled for the initial session on May 7 at 9:30 A.M.; *Pilot Plant Investigations of the Biological Filtration of Petroleum Refinery Wastes* by J. M. Degnan, Junior sanitary engineer, and J. DeMann, biologist-chemist, Atlantic Refining Co., Philadelphia, Pa. at 4:00 P.M., May 7; *B. O. D. of Synthetic Organic Chemicals* by George G. Jenkins, supervisor of design, and Charles B. Lamb, engineer, Carbide and Carbon Chemicals Div., So. Charleston, W. Va., at 10:00 A.M., May 8; and *Reduction of Phenol in Wastes from Catalytic Petroleum Processes* by James A. Biehl, chemist, Ohio Oil Co., Robinson, Ill., at 4 P.M.

Oil Man's Calendar

APRIL

Petroleum Industry Electrical Assn. & Petroleum Electric Supply Assn., 24th annual meeting, Mayo Hotel, Cimarron Ballroom, Tulsa, Okla., April 14-17.

National Petroleum Association, semi-annual meeting, Hotel Cleveland, Cleveland, O., April 16-18.

American Institute of Chemical Engineers, symposium on corrosion, Akron, O., April 21.

Independent Petroleum Assn. of America, mid-year meeting, Deshler-Wallick Hotel, Columbus, O., April 28-29.

Natural Gasoline Association of America, 31st annual convention, Rice Hotel, Houston, Texas, April 30-May 2.

MAY

Association for Computing Machinery, spring meeting, Mellon Institute, Pittsburgh, Pa., May 2-3.

American Chemical Society, Division of Gas and Fuel Chemistry, School of Mineral Industries, Pennsylvania State College, State College, Pa., May 5-6.

National Air Pollution Symposium, second annual meeting, Hotel Huntington, Pasadena, Calif., May 5-6.

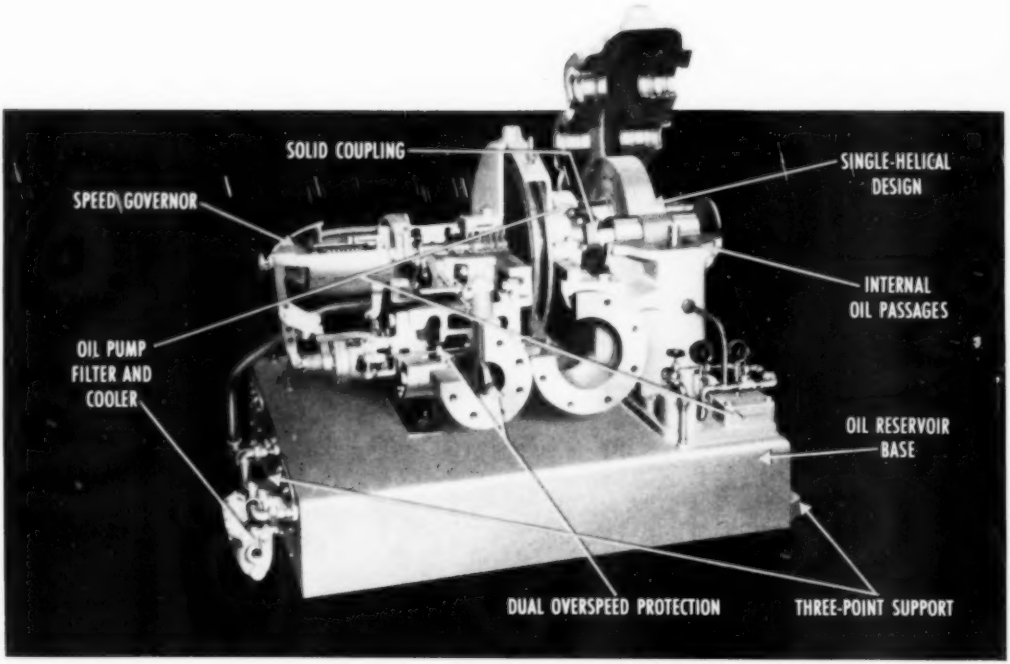
Greater Chicago Safety Council, 29th annual Midwest Safety Show, Congress Hotel, Chicago, Ill., May 5-8.

Scientific Apparatus Makers Assn., annual meeting, Edgewater Beach Hotel, Chicago, Ill., May 6-9.

7th Purdue Industrial Waste Conference, Purdue Memorial Union, Purdue University, Lafayette, Ind., May 7-9.

American Institute of Chemical Engineers, regional meeting, French Lick Springs Hotel, French Lick, Ind., May 11-14.

American Institute of Chemical Engineers, regional meeting, Atlanta, Ga., May 11-14.



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Carry-Over on Heating Oil Stocks In Most U.S. Refining Districts

THE nation's refiners had in their storage tanks on March 15 245,132,000 bbls. (API data) of principal refined products, at approximately the time when the seasonal buildup of gasoline stocks is completed and as the low tide for heating oil stocks approaches. This volume was 8,658,000 bbls. (3.6%) more than on March 17, 1951, as shown in Table 1, which also shows refinery stocks as of March 18, 1950.

Refiners east of California, on March 15, had 213,727,000 bbls. of principal stocks on hand. This was 29,036,000 bbls. (over 13%) more than the amount held on March 17, 1951, reflecting the drop in stocks in California of over 11,000,000 bbls. in the same period.

For the districts east of California, gasoline stocks on March 15 were 7,367,000 bbls. (nearly 6%) larger than on March 17, 1951; kerosine stocks were 2,174,000 bbls. (over 17%) larger; distillate stocks were 5,101,000 bbls. (over 17%) larger and residual fuel oil stocks were 5,094,000 bbls. (nearly 25%) greater than on March 17, 1951. From these stocks on hand and, to a much greater extent, from current plant operations will come the material to supply an overall domestic product demand for this area estimated at from 6-7% larger than in 1951.

These changes in volume of stocks on the two dates, for the country east of California, are by no means typical for individual districts. The relative stock changes in districts vary greatly, due to changes in the volume of crude processed, in market demand and in other local factors. These conditions will influence plant operations in coming months more than the overall supply-demand situation.

The East Coast refining district, for example, had a slightly smaller total of products in storage the middle of March than a year ago. The total was 53,867,000 bbls. on March 15, compared with 54,147,000 bbls. on March 17, 1951. Gasoline stocks, 26,540,000 bbls., were around 2.5% lower. Kerosine and distillate stocks were also slightly lower. Residual fuel was the only product in the East Coast district to show an increase. That was from 8,176,000 bbls. to 8,914,000 bbls. (about 9%). There is no great difference in the volume of crude run in March in this territory as compared with March a year ago.

The East Coast district historically operates to a higher yield of distillate fuels than other districts, to enable it to take care of the concentrated heating oil markets in this part of the country and New England. Its buildup in gasoline stocks from early November, 1951, to March 15 was about 11%, compared with a buildup of over 33% for all districts east of California. This same condition held in the 1950-51 buildup period also.

In the Gulf Coast districts (Texas and Louisiana) total stocks of principal refined products were 12% larger than on March 17, 1951. There was a nominal increase in gasoline stocks, but stocks of heating oils (kerosine and distillate fuels) were nearly 3,800,000 bbls. (over 35%) larger and residual fuel stocks were about 25% larger. While the volume of crude runs in the Gulf Coast districts was around 165,000 b/d avg. (8%) larger in early March this year than last, the large increase in the volume of distillate fuels in storage also reflects price and transportation costs which this winter made it uneconomic for all marketers to move material from the Gulf Coast into the eastern markets.

In the Indiana-Illinois-Kentucky district, product stocks March 15 totaled nearly 51,500,000 bbls., 15% larger than the approximately 44,600,000 bbls. in storage there on March 17, 1951. Gasoline stocks were about 12% larger, and heating oils over 13% larger. This district carried much larger stocks of distillate fuels until well into February, when heavy drafts began to reduce them. The largest stock gain in this district is in residual fuels, the total of 1,976,000 bbls. in refiners' tanks March 15 being over 60% larger than the total of 3,073,000 bbls. on hand March 17, 1951.

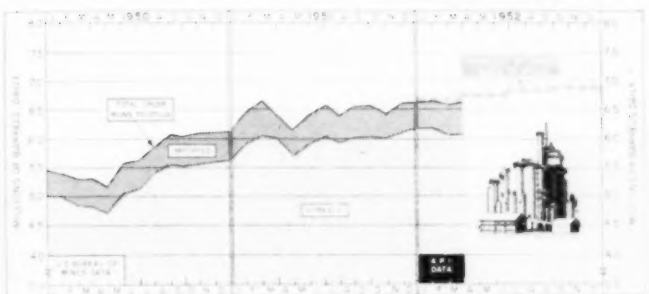
In the Okla.-Kans.-Mo. district, total stocks of 26,396,000 bbls. March 15 were about 14% larger than the total of 23,104,000 bbls. March 17, 1951. Gasoline stocks were 8% greater this year, kerosine and distillate stocks combined 27% larger and residual fuel stocks about 20% greater. There was little difference in crude runs in the two periods.

Table 1—Product Stocks at U. S. Refineries in March, 1952-'51-'50, API data

(1000 Bbls.)

	Total U. S. March 15, 1952	March 17, 1951	March 18, 1950
Gasoline	116,185	110,671	100,602
Kerosine	14,941	13,094	12,902
Distillate	47,972	44,966	43,102
Residual	36,034	32,753	31,906
Total	245,132	236,474	208,512
	East of California		
Gasoline	130,999	123,538	114,400
Kerosine	14,738	12,564	12,774
Distillate	42,565	37,134	33,330
Residual	25,425	20,445	18,976
Total	213,727	193,681	179,580
	California		
Gasoline	15,266	17,133	20,643
Kerosine	203	320	424
Distillate	5,417	7,812	9,206
Residual	10,525	17,318	23,300
Total	31,405	42,782	53,117

Fig. 1—March Crude Runs Hold at '52 Level



Crude Runs to Stills

Daily Average (1000 bbls.)

	Domestic	Foreign	TOTAL
Mar. '52 API*	6,170	340	6,510
Mar. '52 BM	6,060	460	6,520
Change	+110	-120	-10
% Change	1.8	-26.1	-0.2
Through March 22			
Total (1000 bbls.)			
Mar. '52*	160,257	27,442	186,699
Mar. '52	160,372	28,462	188,834
Change	-115	-1,020	-2,135
% Change	0.1	-3.6	-1.1

* Estimated from API data

BM Forecast of Crude Runs to Stills, 1952

	Gasoline	Kerosine	Dist. Fuels	Resid. Fuels
	%	%	%	%
Mar. '52 API*	42.1	5.3	25.6	19.1
Feb. '52 API	42.1	5.3	25.6	19.4
Jan. '52 API	42.1	5.2	25.6	19.3
Mar. '51 BM	41.6	6.2	25.4	20.8

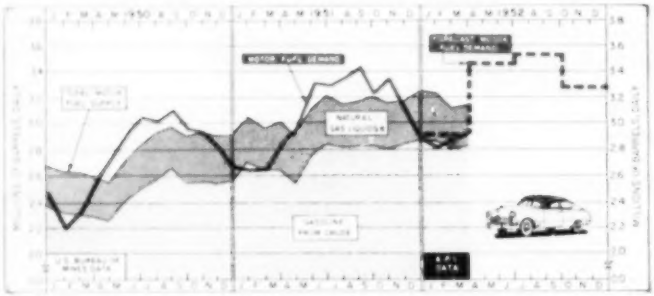
* On March 22

Yields on Crude Runs to Stills

	Gasoline	Kerosine	Dist. Fuels	Resid. Fuels
	%	%	%	%
Mar. '52 API*	42.1	5.3	25.6	19.1
Feb. '52 API	42.1	5.3	25.6	19.4
Jan. '52 API	42.1	5.2	25.6	19.3
Mar. '51 BM	41.6	6.2	25.4	20.8

* On March 22

Fig. 2—Seasonal Upswing in Motor Fuel Demand



* Natural Gas Liquids include gasoline blended at refineries, and that used as finished motor fuel.

Fig. 3—Gasoline Stocks Nearing 150,000,000 Bbls.

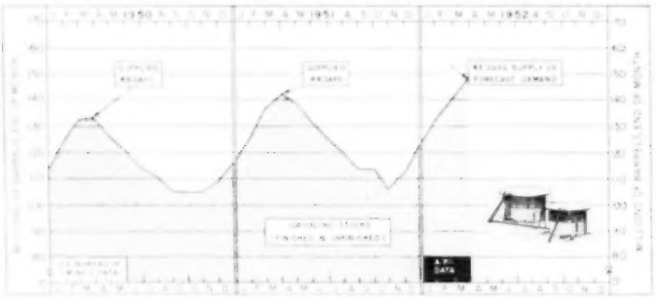


Fig. 4—Heating Oil Output Slackens in March

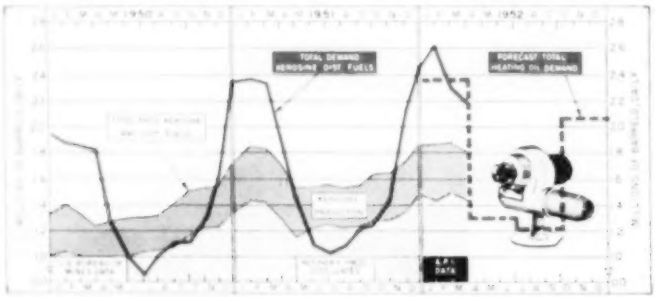
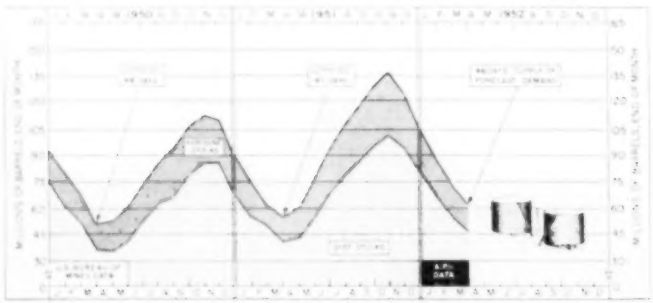


Fig. 5—Pull on Heating Oil Stocks is Easing



Motor Fuel Supply

Daily Average (1000 bbls.)

	Gasoline from Crude	Natural Blended Used Direct	TOTAL
Mar. '52 API*	2,920	300	3,186
Mar. '51 BM	2,650	362	3,012
Change	+270	−62	+168
% Change	6.8		5.5

* Through Mar. 22

Total (1000 bbls.)
(Bureau of Mines Data)

2 mos. '52*	169,240	21,910	191,150
2 Mos. '51	156,168	17,716	173,884
Change	+13,072	+4,194	+17,266
% Change	8.4	23.7	9.7

* February from API data

Motor Fuel Demand

Including Exports
Daily Average (1000 bbls.)

Mar. '52 API*	2,955
Mar. '51 BM	2,878
Change	+77
% Change	2.6

* Through Mar. 22

Total (1000 bbls.)
(Bureau of Mines Data)

2 Mos. '52*	173,675
2 Mos. '51	158,666
Change	15,009
% Change	9.5

* February from API data

BM Forecast of Motor Fuel Demand, 1952
(Nov. 28, 1951) bbls. avg. for quarters)
1st Q., 2,920; 2nd Q., 3,180; 3rd Q., 3,365; 4th Q., 3,094

Gasoline Stocks

Finished and unfinished, end of month (1000 bbls.)

Mar. '52 API*	147,046
Feb. '52 API	142,641
Jan. '52 BM	135,118
Mar. '51 BM	141,458

* On March 22

Heating Oils Production

(Kerosine and Distillates)
Daily Average (1000 bbls.)

	Kerosine	Dist. Fuels	TOTAL
Mar. '52 API*	365	1,440	1,805
Mar. '51 BM	289	1,027	1,316
Change	+76	+413	+489
% Change	26.3	40.2	37.2

* Through March 22

Total (1000 bbls.)
(Bureau of Mines Data)

2 Mos. '52*	25,107	86,318	111,425
2 Mos. '51	24,193	81,983	106,176
Change	+914	+4,335	+5,249
% Change	3.8	5.2	5.1

* February from API data

Heating Oils Demand

Daily Average (1000 bbls.)

	Kerosine	Dist. Fuels	TOTAL
Mar. '52 API*	405	1,540	1,945
Mar. '51 BM	392	1,465	1,857
Change	+13	+75	+88
% Change	3.3	5.1	4.7

* Through March 22

Total (1000 bbls.)
(Bureau of Mines Data)

2 Mos. '52*	31,497	118,060	149,747
2 Mos. '51	30,761	109,176	139,937
Change	+736	+8,884	+9,810
% Change	2.3	8.1	6.9

* February from API data

BM Forecast of Heating Oils Demand, 1952
(Nov. 28, 1951) bbls. avg. for quarters)
1st Q., 2,235; 2nd Q., 1,308; 3rd Q., 1,220; 4th Q., 2,087

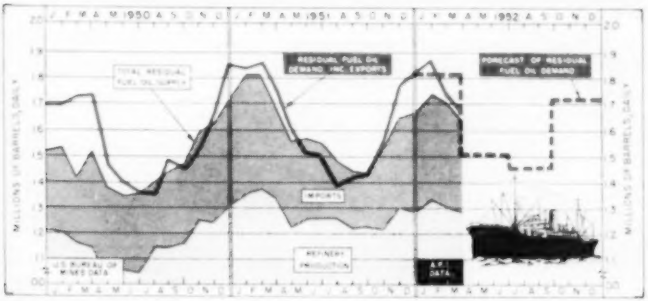
Heating Oil Stocks

(1000 bbls. end of month)

	Kerosine	Dist. Fuels	TOTAL
Mar. '52 API*	34,308	46,188	80,496
Feb. '52 API	34,221	48,830	83,051
Jan. '52 BM	39,419	43,550	82,969
Mar. '51 BM	33,407	42,928	76,335

* Through March 22

Fig. 6—Seasonal Drop in March Residual Demand



Residual Fuels Production

Daily Average (1000 bbls.)

	Refinery Output	Imports	TOTAL
Mar. '52 API*	1,292	373	1,665
Mar. '51 BM	1,348	353	1,701
Change	−56	+20	−36
% Change	4.2	5.7	2.1

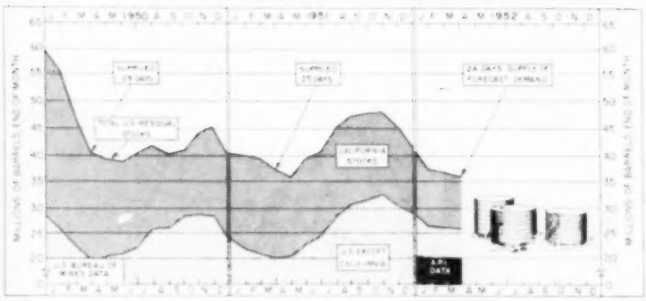
* Through March 22

Total (1000 bbls.)
(Bureau of Mines Data)

3 Mos. '52*	79,936	24,920	105,115
3 Mos. '51	81,083	25,344	107,027
Change	−1,147	−424	−1,912
% Change	2.4	1.4	2.7

* February from API data

Fig. 7—Small Withdrawals of Residual Fuel Stocks



Residual Fuels Demand

Daily Average (1000 bbls.)

Mar. '52 API*	1,685
Mar. '51 BM	1,715
Change	−30
% Change	1.7

* Through March 22

Total Demand (1000 bbls.)

3 Mos. '52*	105,035
3 Mos. '51	105,300
Change	−265
% Change	09

* February from API data

BM Forecast Residual Fuels Demand, 1952
(Net, 28° API and heavier, bbls. per day, by quarters)

1Q—1,800; 2d Q—1,650; 3d Q—1,450; 4th Q—1,739

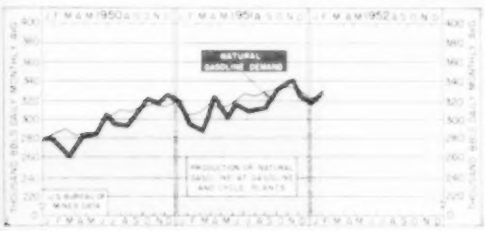
Residual Fuel Stocks

1000 bbls. end of month

	U. S. Except California	Total U. S.
Mar. '52 API*	27,422	36,094
Feb. '52 API	26,510	34,558
Jan. '52 BM	27,215	34,260
Mar. '51 BM	30,024	37,510

* On March 22

Fig. 8—Production and Demand of Natural Gas Liquids



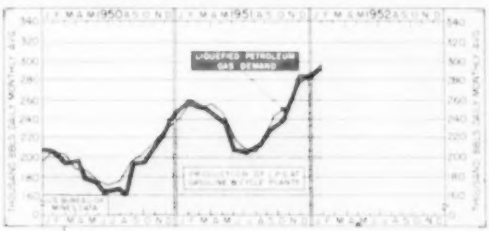
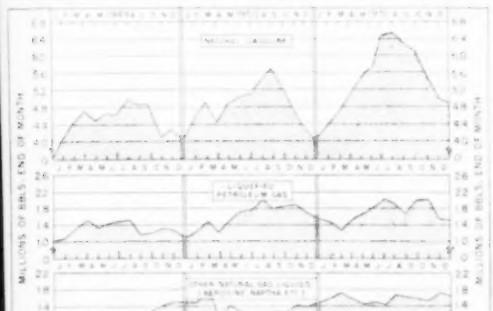

LIQUEFIED PETROLEUM GAS DEMAND
PRODUCTION OF LIQUEFIED PETROLEUM GAS AT CYCLE PLANTS
THOUSAND BBLS DAILY MONTHLY AVG

Fig. 9—Stocks of Natural Gas Liquids



* This chart has not been extended for January '52, because of a change in method of reporting. Current stocks figures are not comparable.

Natural Gas Liquids Statistics

Source: U. S. Bureau of Mines Report on Natural Gasoline and Cycle Plant Operations

	Production* (1000 bbl. day avg.) Natural Gasoline	LPG**	TOTAL	Demand** (1000 bbl. day avg.) Natural Gasoline	LPG	TOTAL
Jan. '52	397	262	659	397	266	663
Jan. '51	375	241	616	393	240	633
Change	+22	+21	+43	+4	+26	+30
% Change	5.9	8.7	7.0	1.0	10.8	4.7

	Total Production (1000 bbl.) Natural Gasoline	LPG	TOTAL	Total Demand (1000 bbl.) Natural Gasoline	LPG	TOTAL
12 Mos. '51	137,045	93,807	230,852	135,063	87,936	223,339
12 Mos. '50	130,833	78,243	209,076	130,139	73,372	180,421
Change	+6,212	+15,564	+21,776	+4,924	+14,564	+42,918
% Change	4.7	20.4	10.9	3.7	20.2	12.6

Stocks, End of Month (1000 bbl.)

	By Type of Product — At gasoline plants and terminals only: LPG	Natural Gasoline	Conden-sate	Finished Gasoline†	By Location — Refineries	Gasoline Plants	TOTAL
Jan. '52	1,160	2,916	159	1,421	2,021	3,275	5,296
Dec. '51	1,260	2,442	198	1,427	2,642	3,544	6,186
Jan. '51		(Figures not available)			2,268	3,087	5,355

* Supply includes receipts from refineries as well as current production from natural gasoline and cycling plants. Receipts from refineries in January included 1,000,000 bbls. of natural gasoline and 200 bbls. of naphtha.

** Demand does not include liquefied refinery gases produced for fuel and chemical purposes which totaled 1,442,000 bbls. in January.

† Includes naphtha and other products.

ADVERTISERS' INDEX

FOR INFORMATION ON ANY PRODUCT OR SERVICE ADVERTISED IN THIS ISSUE SEE INSTRUCTIONS BELOW

Each advertiser listed in this index has been assigned a code letter for use by the reader in securing additional information about advertised products or services which interest him. This code letter appears in parentheses to the left of the advertiser's name.

●

Circle the code letter on the "Advertised Product Inquiry" card (on the page opposite) which corresponds to that assigned the advertiser about whose product you want further information.

Fill in your name, title, company and mailing address and mail the card . . . no postage is required.

The Petroleum Processing Reader Service Department will give your inquiries prompt and efficient handling.

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(A4) ALUMINUM CO. OF AMERICA 535
(A5) ALUMINUM CO. OF AMERICA 542
(A6) AMERICAN CYANAMID CO. 445
(A7) ANACONDA COPPER MINING CO. 432
(A8) ANDERSON CO., THE V. D. 540
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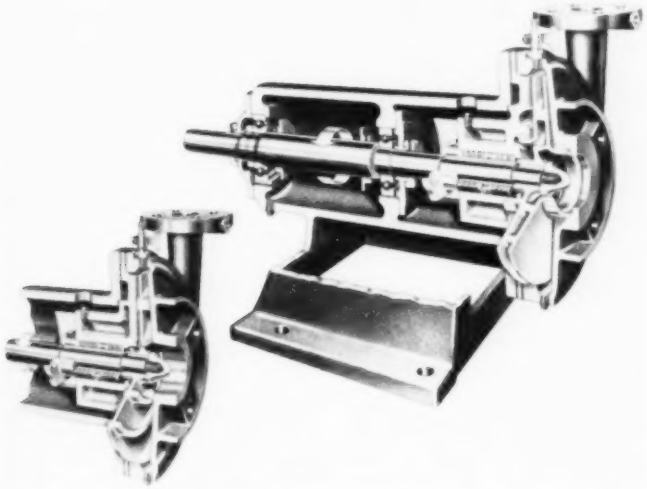
(L1) WRIGHT CHEMICAL CORP. 560
(L2) WYATT METAL & BOILER WORKS Outside Back Cover

WHAT'S NEW . . .



CHEMICAL PROCESS PUMP handles corrosive and abrasive liquids, with solids in suspension up to 5% by volume

No Job Too Tough for this Pump

A new centrifugal pump, the type "DS", is available in discharge sizes from 1 in. through 6 in. providing a range for most chemical process applications. The pump meets requirements for most process liquids, hot or cold, in moderate capacities against low, medium, or high heads. Special emphasis is placed on corrosive and abrasive liquids with solids in suspension up to 5% by volume. Enclosed or open impeller design is optional. Using the enclosed impeller, capacities up to 600 gpm are provided. Open impeller offers a capacity range up to 1000 gpm. "Type DS" will operate against heads to 231 ft. Driver is standard, horizontal, electric motor mounted on a common base with the pump. The pump is offered in two basic designs, one grease-lubricated, the other oil-lubricated. Either grease or oil lubrication is available with enclosed or open impellers. Standard bearing construction for operation at temperatures to 250° F. is grease-lubricated. Above 250° F. to 600° F. oil-lubricated construction is utilized. This latter construction is also available for pumps handling liquids to 250° F. Cooling coils are provided in the oil-lubricated pump for maintaining oil supply at proper temperature. Coils are connected to an external supply through tapped connections in the side of the pump case. Provision is also made for water cooling the packing. It is tapped for in-and-out water cooling connections for temperatures to 300° F. Where a positive seal is desired the pump can be equipped with a mechanical shaft seal. Liquid ends can be made of any required alloy, depending on intended service. The liquid end consists essentially of three parts: the case, the impeller and the back head. Removal of case frame units permits removal of these three components for fast inspection and maintenance. Reassembly time is correspondingly brief. Fosd Machinery and Chemical Corp., Peerless Pump Div., 301 W. Ave. 26, Los Angeles 31, Calif.

Circle No. 1 on Reply Card

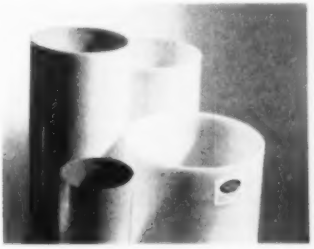
For More Information

Use one of the attached reply cards to request additional details or literature on any items reviewed in "What's New!" Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the rest of the card and drop it in the mail. No postage required.

Internal Tank Activity and Liquid Level Observed with Sight Gage

The "Rucker Reflex Sight Gage", designed to replace external glass gages with their attendant valves, is now being manufactured. The gage is adaptable to any equipment where it is desirable to observe the liquid level or the internal activity of tanks, vats or vesels. Liquid level is easily observed from angles up to 15° off vertical or horizontal. The standard model is made with cast iron housing, fluted pyrex-type sight glass and asbestos gaskets, and is designed for temperatures to 500° F. and vacuum or pressures to 15 psi. The gage can be furnished with transparent glass, and the housing made of cast stainless steel or vitreous enameled cast iron. It mounts on existing vessels without burning or welding. Standard visible length is 4½ in., but the gage can be manufactured on special orders with visible lengths up to 12¾ in. The Rucker Mfg. Co., 4516 Hollis St., Oakland 8, Calif.

Circle No. 2 on Reply Card



Plastic Used in Piping Systems More Effective than Metal Pipe

Testifying to the importance of plastic tubing in the defense effort, the Navy's Bureau of Ships has found polyester, "Fibreglas"-reinforced plastic pipe an ideal substitute for copper-nickel and copper-brass shipboard piping systems. The Navy tests showed reinforced plastic pipe superior to metal pipe in resistance to corrosion and shock and lower in installation and maintenance costs. Lightweight "Reflin" tubing is available in standard sizes from 4-10 in. O. D. with wall thicknesses ranging from .030 in. Sizes up to 36 in. O. D. are available to order. The plastic

pipe has a tensile strength up to 35,000 psi and a flexural strength up to 65,000 psi. Varying with diameter and reinforcement, burst pressures range to 3000 psi. Straight sections of 20 ft. lengths are coupled by cemented sleeves. Reflin is suitable for piping installations with standard fittings. The pipe is corrosion-resistant to weather, soil, corrosive liquids and gases, dilute alkalis, salts, aliphatic and aromatic hydrocarbons, greases, alcohols, and gasoline. Temperature stability assures continuous operation between temperatures ranging from −60° F. to 250° F. It is readily worked with standard machine tools and can be sawed, cut, drilled, threaded or joined. Reflin Co., Dept. B-11, 5825 Higuera, Culver City, Calif.

Circle No. 3 on Reply Card

Lead Grease Lube Is Improved By New Homogenizing Process

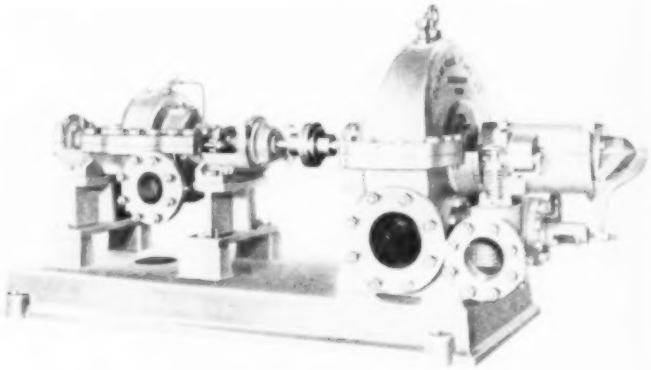
"Lead-Lube" is a new heavy duty grease lubricant, made possible through advances in the field of powdered metallurgy and by a new homogenizing process. An important factor in the lubricant is its high metallic lead content in the form of a pulverized lead dust, kept in permanent suspension by the homogenizing process. The function of the lead is to form self-lubricating surfaces over all wearing parts in gears and bearings. In the case of older equipment, the metallic lead will re-surface pits and scores. Service life of equipment exposed to attack from water or corrosive chemicals likewise is improved by the lead surface. Knapp Mills, Inc., 23-15 Borden Ave., Long Island City 1, N. Y.

Circle No. 4 on Reply Card

Giant Fog Nozzle Fights Large Fires Up to 80 Feet Away

Made especially to fight large fires in or out-of-doors, a giant-size fog nozzle is capable of delivering a 500 gpm. fog blanket with a large diameter of coverage and an effective reach of almost 80 ft. The manufacturer states that the tremendous cooling effect of this large volume of fog will almost instantly extinguish large flammable liquid fires and other types of hot fires. Made with a 2½-in. National Standard Thread connection, the nozzle can be attached directly to a hose or turret gun having this thread, in place of the conventional straight stream nozzle. The nozzle is made of bronze and has external vanes for added strength in rough service. A unique feature of the piece is its patented spiral atomizing element which contains no small orifices or internal parts. Bete Fog Nozzle Inc., 85 Pierce St., Greenfield, Mass.

Circle No. 5 on Reply Card



DOUBLE IMPACT ROTORS raise turbine horsepower from 500 to 1000

Steam Turbine Output Is Doubled

The "DH Steam Turbine" has been developed on the principle of directing steam *twice* against a single row of blades by use of special steam-reversing nozzles, thus giving double impact to the rotor and converting energy within the steam into useful work. The turbine, a single stage impulse, double impact type, formerly developed 500 hp. with pressures up to 600 psi. at 700° F. Now with the new design, they are capable of developing 1000 hp. with pressures up to 875 psi. at 750° F. They are extremely well adapted for mechanical drives with pumps, fans, blowers, and other plant auxiliaries. The design of the turbine does not allow high pressure steam to come into contact with casing. All high pressure parts and joints are outside and visible to the operator. Special materials and special controlling devices designed for severe conditions are eliminated. Maintenance is relatively simple. Dean Hill Pump Co., Dept. A, 4000 E. 16th St., Indianapolis 7, Ind.

Circle No. 6 on Reply Card

Teflon Packing Offers Greater Resiliency and Lower Cost

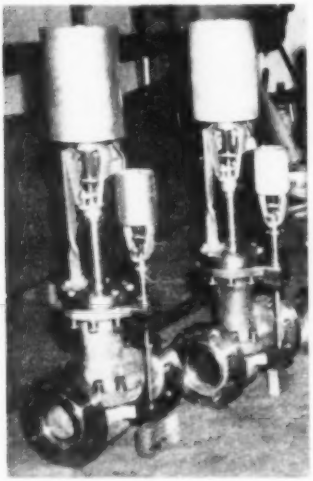
A braid-over-braid asbestos packing, impregnated with Teflon throughout, and known as "Flexrock #401 Packing", imparts superior resiliency to the Teflon by the integral asbestos fibres. This resiliency permits a tight, lasting seal at low gland pressure and solves the cold flow problem, many times encountered with solid Teflon packing. Moderately priced, #401 can't be attacked by, nor contaminate any industrial acids, alkalis or solvents. It is serviceable from −100° F. to +500° F. Furnished in continuous lengths, square cross section, the packing comes in sizes from ⅛" to 1" by 1/16" increments. Mechanical Packing Division, Flexrock Co., 3670-A Cuthbert St., Philadelphia 4, Pa.

Circle No. 7 on Reply Card

Latest Laboratory Desiccator Made of Cast Aluminum Alloy

Now in production is a new, lightweight, "lifetime," cast aluminum desiccator. The desiccator weighs only a fraction of a comparable glass desiccator, is priced at the same level as the flimsiest kind of light gauge sheet metal desiccator on the market, and cannot be damaged by bumping or dropping, the manufacturer states. It is 4½ in. square and has a cast aluminum alloy body and cover. A ground joint seal assures air tight closure and the aluminum body dissipates the heat quickly. Laboratory Industries, Inc., 4710 W. North Ave., Chicago 39, Ill.

Circle No. 8 on Reply Card



Control Valves Handle Various Materials at Operating Extremes

Two new control valves, Models 1570 and 1580, capable of handling a wide variety of materials at temperature and pressure extremes, are now available. Materials handled include liquid nitrogen, which can be handled at a temperature of —325° F., and a pressure up to 3000 psi.; red fuming nitric acid at room temperatures; and superheated steam up to 1000° F. The design feature of these single seated valves with split-body construction, is the external self-balancing arrangement which provides a balanced valve effect in operation. Under extreme pressure differentials, a positive bubble-tight shut off is retained. The valves can be serviced without removal from line. In severe corrosive service the lower half of the valve body, relatively inexpensive, is easily replaced with minimum downtime. No special tools are required. Model 1570, illustrated in the above photograph, has an electro-pneumatic operator for on-off service. Model 1580 employs a Domotor operator for throttling service. Annin Co., 3500 Union Pacific Ave., Los Angeles 23, Calif.

Circle No. **9** *on Reply Card*

Packaged Cooling Towers Made Of Redwood for Rugged Use

A low cost line of prefabricated cooling towers, known as "Cotospray" towers, are now available. These towers are unconditionally guaranteed to deliver thermal performance for the life of the structure. Towers are built of carefully selected Redwood, all sap-free. All bolts, nuts, washers, and nails are galvanized steel. The distribution header is of steel and nozzles are bronze, non-clogging type. Louvers are 1" surfaced redwood. Basins are leak-proof steel pan type, up to and including $10\frac{1}{2}$ x 10 ft. size, with redwood sideboards through-bolted to basin stills. Manufacturer states towers are easy to install. All towers are complete with necessary accessories. J. F. Pritchard & Co., 908 Grand Ave., Kansas City 6, Mo.

Circle No. **10** *on Reply Card*

Aromatics Detector Will Handle Benzene, Toluene and Xylene

The new M.S.A. Aromatic Hydrocarbon Detector determines toxic concentrations of benzene, toluene, and xylene. It is of the familiar aspirator tube type with separate graduations for each of the aromatics on the same cylindrical indicator scale. Stability of the indicating material in the detector tubes is said to be assured because tubes are filled in the field. Twelve tubes can be filled at one time and stored for two to three weeks without variation of sensitivity. Maximum allowable concentrations of petroleum hydrocarbons, chlorinated hydrocarbons, natural gas, alcohols, and carbon monoxide have no significant effect. Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh 8, Penn.

Circle No. **11** *on Reply Card*

DID YOU MISS THESE?

The following items, reviewed originally in the February issue, have aroused considerable interest. They are repeated briefly as a service to those who might have missed them. For details or literature, use the regular Reply Cards in this issue.

Alarm Unit Accounts for All Vapors in Dangerous Atmosphere

A completely explosion-proof, combustible gas alarm unit, Model EE, can be installed in areas where gas or volatile liquids are used, stored, or handled, to provide a continuous safeguard against any kind of explosive vapors. Signal is by a bright red indicator light and remote alarm units. Self-reset or lock-in arrangements can be had for a choice between an on-off indication or one which must be manually reset. Completely AC operated, the device contains no meters or meter-type sensitive relays, but uses an electronic trigger-tube circuit. Stand-by power consumption from 115 volt line is 15 watts. Johnson-Williams Ltd., 2686 Third St., Palo Alto, Calif.

Circle No. **12** *on Reply Card*

Pourable Cement Permanently Sets Anchor Bolts in Half Hour

Anchor bolts, for permanently fastening equipment of any type to concrete, can be set quickly using "Por-Rok" Cement. Manufacturer states that the bolt is securely anchored within 15 to 30 minutes after application. The material is self-bonding, self-leveling, oil resistant, and will not shrink. If can be applied cold, eliminating any heating hazard. A compression strength of 4500 psi. has been verified. Hallemite Mfg. Co., Dept. PPR, 2446 W. 25 St., Cleveland 13, Ohio.

Circle No. **13** *on Reply Card*

Octane Improvements

Mechanical Octane Numbers, by Earl Bartholomew; 14-page brochure defining mechanical octane numbers, with comparisons of performances of a 1950 engine to a 1939 engine; research on combustion and combustion chamber design; advantages and disadvantages of supplementary fuel devices; improvements in fuels. Ethyl Corp., 100 Park Ave. Bldg., New York 17, N. Y.

Circle No. **14** *on Reply Card*

First Aid for Scrap Salvage

Rapid Identification of Some Metals and Alloys; 50-page booklet covering spot tests for most common metals and alloys encountered in scrap drives, as an aid in identification. International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.

Circle No. **15** *on Reply Card*

ORONITE
LUBE OIL
ADDITIVES

to meet your price and performance requirements

ORONITE ADDITIVES are tailor-made to your base oils, to meet your price and performance specifications. Too, lube oil compounders find treating costs lower because of the high activity detergent and inhibitor chemicals used in making Oronite Additives.

Years of service in the field, continuous engine testing and rigid quality control throughout our manufacturing process is your assurance of uniformity and complete dependability.

Why not talk over your problem with us. The Oronite office nearest you will give complete information and recommendations.

With Oronite Additives you can qualify for 2-104-B, MIL-O-2104, Supplement I and Series II quality oils.

ORONITE CHEMICAL COMPANY

ORONITE CHEMICAL COMPANY

38 SANSOME ST., SAN FRANCISCO 4, CALIF. STANDARD OIL BLDG., LOS ANGELES 15, CALIF.
30 ROCKEFELLER PLAZA, NEW YORK 20, N.Y. 600 S. MICHIGAN AVENUE, CHICAGO 5, ILL.
MERCANTILE SECURITIES BLDG., DALLAS 1, TEXAS

2388

What's New!

Machine Cleans Intricate Parts Of Industrial Instruments

"Instro-Met" has been designed specifically for cleaning every kind of instrument with small or large, delicate parts from time clock, to bearings and screw machine parts. The final model has been tested for months under actual working conditions. Features of the new cleaning device include:

1) Three clear-view windows on motor support for instant checking while machine is in operation.

2) Spun aluminum tanks and covers instead of hazardous glass. All are 10 in. high and have 10 in. diameters. 4 gal. capacity.

3) Heavy cast aluminum basket with 33-1 3/4 more capacity, 7-3/16-in. inside diameter; 3 3/4 in. deep. Basket also has three monel mesh removable compartments for cleaning a variety of parts simultaneously.

4) Simple snap-on operation of basket to impeller shaft eliminates hazards of accidental loosening. Inner steel tube of center supporting column is splined for automatic centering over tanks and dryer. Basket lowers only when in proper position. "Fingertip" control enables female operator to work the machine without fatigue.

5) Overall size: 23 1/4 x 26 1/4 x 26 in. Other advantages of Instro-Met are the 14 to 1 gear reduction, ball bearing motor A.C.-D.C. with reversing action; motor-driven unit for faster drying; heavy cast aluminum base assuring steady, smooth, vibrationless performance. The weight of the basket and parts is supported by ball and needle bearings, taking all thrust off the motor. A master switch controls the entire machine. There are reversing switch, heater switch and rheostat control for the various motor speeds. Zenith Mfg. and Chemical Corp., 52 Beekman St., New York 38, N. Y.

Circle No. **16** *on Reply Card*

Cancer strikes one in five

Strike back

By saving lives, by easing pain, by improving services to cancer patients, by supporting research that will find the final answers to cancer . . .

That is how your dollars strike back at cancer when you give them to the American Cancer Society.

Send your gift today by mailing it to "Cancer" care of your local post office.

Give to conquer cancer

American Cancer Society

What's New!

Squeeze of Reservoir Bottle Readies Burette for Titration

Simply squeezing the plastic reservoir bottle fills the "Squeez-O-Matic", automatic, self-levelling burette ready for titration. This unique laboratory device comes as one unit, complete with burette, reservoir and base. It requires the use of only one hand to operate. Use of a specially machined polyethylene bottle as the reservoir, not only makes the operation of the burette unit easier and simpler but also provides a container which is highly resistant to chemical attack and will not contaminate standard titrating solutions. The special base, also made of a plastic material, is extremely resistant to either mechanical damage or chemical attack. A molded stopper arrangement for the plastic bottle is designed to hold the burette rigidly in position and provide a firm seal between bottle top and burette. The burette units are available in 25 ml and 10 ml sizes, graduated to tenths of an ml. Hagan Corp., 323 Fourth Ave., Pittsburgh, Pa.

Circle No. **17** *on Reply Card*

Strip-Paper Analyses Facilitated With Chromatographic Assembly

It has long been known that solutes migrate through filter paper by capillary action. From this phenomenon "paper chromatography" was born. To standardize tools in this extensively used technique, and with the purpose of eliminating awkward makeshifts, a complete apparatus for strip-paper analyses has been developed. Included in the apparatus is a stainless-steel support rack to hold the

MAGNABOND magnetic coupling

A BASIC ADVANCE IN INSTRUMENTATION

. . . eliminates the stuffing box

. . . ideal for difficult fluids

SIMPLE SAFE PRECISE

Armored FLOWRATOR Meter with MAGNABOND operated close-coupled indicator-pneumatic transmitter.

The FLOWRATOR flow meter, combined with the patented separation-proof MAGNABOND magnetic coupling, provides the best means of metering any fluid. The MAGNABOND coupling picks up the FLOWRATOR metering float position without the need for stuffing boxes or torque tubes, thus providing an ideal solution for problems of metering corrosive or explosive liquids, slurries, or fluids under high pressure or temperature. The MAGNABOND coupling can operate indicators, recorders, totalizers, recording controllers, or pneumatic transmitters in various combinations—in close-coupled or remote instruments.

WRITE FOR CATALOG 50

FLOWRATOR

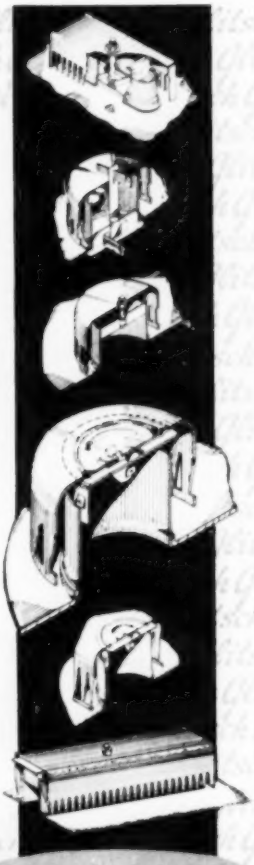
FISCHER & PORTER CO.

DEPT. 2P-1Z

HATBORO, PENNA., U.S.A.

SALES ENGINEERING OFFICES THROUGHOUT THE WORLD

WHAT SHAPE bubble cap do you like?



GLITSCH has existing tooling for more than 200 varied shapes and sizes of caps and risers as well as ingenious methods for holding them in place.

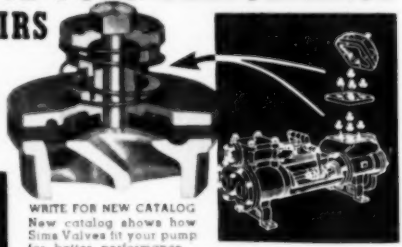
Glitsch

FRITZ W. GLITSCH & SONS, Inc.
BOX 6227 • DALLAS 2
New York Chicago
Houston Cleveland
Tulsa Los Angeles

"TRUSS-TYPE" BUBBLE TRAYS • BUBBLE CAPS • TOWERS • TOWER INTERNALS

HOW TO IMPROVE PUMP PERFORMANCE and CUT REPAIRS

Replace those worn, leaky pump valves with long life Sims Pump Valves. Better performance is guaranteed. (1) Discs rotate for uniform wear while cushioned top and bottom by the liquid. (2) Cushioned stem head and inclined ribbed seat combine to give smoother, faster valve action and take up shock.



SIMS PUMP VALVE CO., INC.

WRITE FOR NEW CATALOG
New catalog shows how Sims Valves fit your pump for better performance.

145 HUDSON ST., NEW YORK 13, N. Y. • M & M BLDG., HOUSTON, TEXAS

What's New!

strips, a glass tray and Petri dish for the solvent, and glass rods for attaching and holding the strips. The entire unit fits into a large cylindrical Pyrex brand glass jar with an outside diameter of 12", an outside height of 24. This closure makes possible the saturated atmosphere required for optimum analyses. The desired atmosphere of saturated solvent vapor is further maintained by a glass cover plate with a stoppered half-inch hole in the center for adding the solvent without lifting the entire top and disrupting the atmospher's equilibrium. The method calls for placing one drop of each sample near the top of an individual paper strip and hanging the strips from the support rack (drops at top). The upper edges of the strips are curled to dip into a $5\frac{1}{2}$ x 4" trough, and solvent is added to this trough after the jar's atmosphere has become saturated with solvent from the lower dish. When capillary action moves the solvent down the strip, components of the original drops separate vertically as individual streaks or bands. The determinations depend on the relative positions of the bands. Staining is used for constituents not naturally colored. Fisher Scientific Co. 717 Forbes St., Pittsburgh 19, Pa.

Circle No. **18** *on Reply Card*

Trade Literature

Petrochemical Catalog

Celanese Organic Chemicals; 40-page catalog listing synthetic organic chemicals such as methanol, formaldehyde, propylene oxide, and many others; with physical properties, shipping and handling directions, toxic properties, and uses; inside back cover shows map of existing plants, terminal and storage points, laboratories, and distributors offices. Celanese Corp. of America, 180 Madison Ave., New York 16, N. Y.

Circle No. **19** *on Reply Card*

Faster Fractionator Design

Turn Hours into Minutes with Automatic Data Analysis; 10 pages describing how a line of electronic computing, reading, and graphic plotting instruments can aid in such applications as handling fractionating tower design data, continuous process results for supervision and control, results of engineering studies and analysis, etc. Telecomputing Corp., Burbank, Calif.

Circle No. 20 on Reply Card

Instrument Fundamentals

Refinery Instruments—What Makes Them Tick? A 40-page reprint of a series of eight articles by Cornelius Shannahan, M. W. Kellog Co., which appeared originally in PETROLEUM PROCESSING during 1951-52. Copies are available at $1.00 each, and may be ordered direct from Platt's Petroleum Publications, by means of the "What's New" reply card in this issue—simply . . .

Circle No. 21 on Reply Card

Reduced Fuel Costs

Results—Hays Combustion Control, Bulletin No. R-8-2500; and eight-page brochure describing how the Scovill Mfg. Co., Waterbury, Conn., utilized the control system to meet steam demands up to 400,000 lb./hr. while achieving an evaporation rate of 12.8, a fuel cost per kw of $.0049, and a cost/1000 lb of steam of $.706. The Hays Corp., Michigan City, Ind.

Circle No. 22 on Reply Card

New Diesel Fuel Additive

An Ignition Improver for Diesel Fuel, New Products Bulletin, Feb. 15, 1952; 14 pages describing performance, effectiveness, physical and chemical properties of DB-36, a mixture of primary amyl nitrates, designed to improve the octane number of the middle distillates, thus increasing the potential output of desired grades of diesel fuels. Ethyl Corp., 100 Park Ave., New York 17, N. Y.

Circle No. 23 on Reply Card

Plastic Pipe Resists Corrosion

Plastic Non-Corrosive Pipe, Bulletin No. G-100; four-page folder describing lightweight, flexible, plastic pipe useful to process industries because of its corrosion-proof construction and easy installation; specifications included. The Plastex Pipe and Extrusion Co. 402 Mt. Vernon Ave., Columbus 3, Ohio.

Circle No. 24 on Reply Card

Infrared Analyzer

Process Control by Continuous Analysis, Bulletin No. 36; six-page brochure gives reasons why infrared absorption is best suited for application to continuous process control in plant stream analysis; data sheet is provided to help in further consideration of instrument applicability to specific plant problems, and a schematic drawing of the optical assembly of the plant stream analyzer is included. Baird Associates, Inc., 33 University Road, Cambridge 38, Mass.

Circle No. 25 on Reply Card

Pipe Tool Data

Beaver Pipe Tools, User's Service Bulletin; 28-page catalog and data book illustrating pipe and bolt machines, hand tools, and accessories; discusses how to locate and correct pipe tool troubles, clarifying 31 different operations; specifications included. Beaver Pipe Tools, 325 Dana St., N. E., Warren, Ohio.

Circle No. 26 on Reply Card

Cast Welding Quality Control

Recommended Practice for the Welding of Steel Castings by the Steel Founders' Society of America; 40-page booklet serving as a guide for industry in establishing acceptable welding practices; contains 35 tables

YOU GET
Increased Throughput
from
Existing Equipment
WITH
METEX MIST
ELIMINATORS
Many refiners have found by experience that Metex Mist Eliminators, installed in stills, towers, drums, evaporators and similar equipment, have increased throughput of on-grade production and reduced operating costs by *removing 95% plus of liquid entrainment.* These knitted wire units literally "wipe out" the liquid droplets entrained in gases. Gases pass through and on . . . freed of entrainment. Liquids fall back against the rising flow.
EASILY INSTALLED
NO MOVING PARTS
Full details on these entrainment separators — sizes, shapes, construction and engineering data — are found in our new 8-page bulletin. Write for your copy today. Just ask for "Metex Mist Eliminators."
METEX
METAL TEXTILE CORPORATION
631 EAST FIRST AVENUE, ROSELLE, N. J.

(To obtain more data on advertised products see page 552)

giving a comprehensive listing of the American Welding Society's classified mild steel and low-alloy electrodes. Complimentary copies will be supplied to engineers and technicians who request the booklet on their business letterhead. Tempil Corp., 132 W. 22nd St., New York 11, N. Y.

Controlled Volume Pumping

Lapp Pulsafeeder, Bulletin No. 300; 24-page booklet describes a piston diaphragm pump designed for accurately metering corrosive or non-corrosive liquid chemicals; freely illustrated with photographs and includes engineering designs, specifications, and tables. Lapp Process Equipment Div., Lapp Insulator Co., Inc., Leroy, N. Y.

Circle No. 27 on Reply Card

Microscope Improvements

Cooke Polarizing Microscopes, Pub. No. CM 7000B; 32 pages illustrating and describing microscopes of new and much-improved design, featuring a trip-in Bertrand Lens and revised substage construction permitting full field illumination at all powers without complicated condenser fittings. The R. Y. Ferner Co., 110 Pleasant St., Boston 48, Mass.

Circle No. 28 on Reply Card

DON'T RISK SCALE AND CORROSION

Control them with

WRIGHT PREVENTIVE MAINTENANCE SERVICE!

EXCESSIVE scale and corrosion in your equipment can result in costly production delays and unnecessary maintenance costs. Hundreds of plants are now using Wright Water Conditioning Chemicals to control, and in many cases eliminate, scale and corrosion in engine jackets, heat exchangers, compressors, cooling tower systems—in fact wherever water is used.

The Wright Service includes more than the chemicals. It starts with a scientific analysis of your water conditioning problems. The recommended solution to your specific problem will be based upon our specialized knowledge gained in years of practical water conditioning experience. Write us or call in your Wright Field Engineer for a study of your system.

Wright CHEMICALS

WRIGHT CHEMICAL CORPORATION

Specializing in Water Conditioning

GENERAL OFFICES AND LABORATORY 635 West Lake Street, Chicago 6, Illinois

Offices in Principal Cities

SOLE DISTRIBUTOR OF NELSON CHEMICAL PROPORTIONING PUMPS

Multi-purpose Lubricant

Moly-sulfide; 40-page booklet discusses 85 uses of molybdenum disulfide as a lubricant in the shop and field; its main uses include assembly and disassembly of closely fitting parts, a lubricant in hot and cold working and forming of metals, also for parts that must function properly at high and low temperatures, and as a non-dust collecting lubricant, and a dielectric lubricant. Climax Molybdenum Co., 500 Fifth Ave., New York 36, N. Y.

Circle No. 29 on Reply Card

Flow Meter Handbook

The F & P Variable-Area Flow Meter Handbook, Pub. No. 10596; 40-page booklet gives assistance in the selection and sizing of variable-area meters and includes a complete description of the meters, as well as tubes and floats and their comparison with variable-head meters; much space is devoted to calibration prediction data and procedure on how to alter the capacity of a Flowrator meter. Fischer & Porter Co., Hatboro, Pa.

Circle No. 30 on Reply Card

Esters, Properties and Uses

Esters, No. F-4766, 36-page booklet describes more than 30 esters with uses, structures, physical properties, and shipping data; special section covers specifications of esters as they are shipped, complemented with control tests recommended for determining these specifications. Carbide and Carbon Chemicals Co., Division of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y.

Circle No. 31 on Reply Card

Unique Face Shield

The New M. S. A. Chest-Mounted Faceshield, Bulletin No. CN-5; two-page bulletin describes and illustrates a chest-mounted faceshield affording ample ventilation, easy adjustment, free movement, and which can be provided with special visors for impact resistance, chemical splashes or hot operations. Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh 8, Pa.

Circle No. 32 on Reply Card

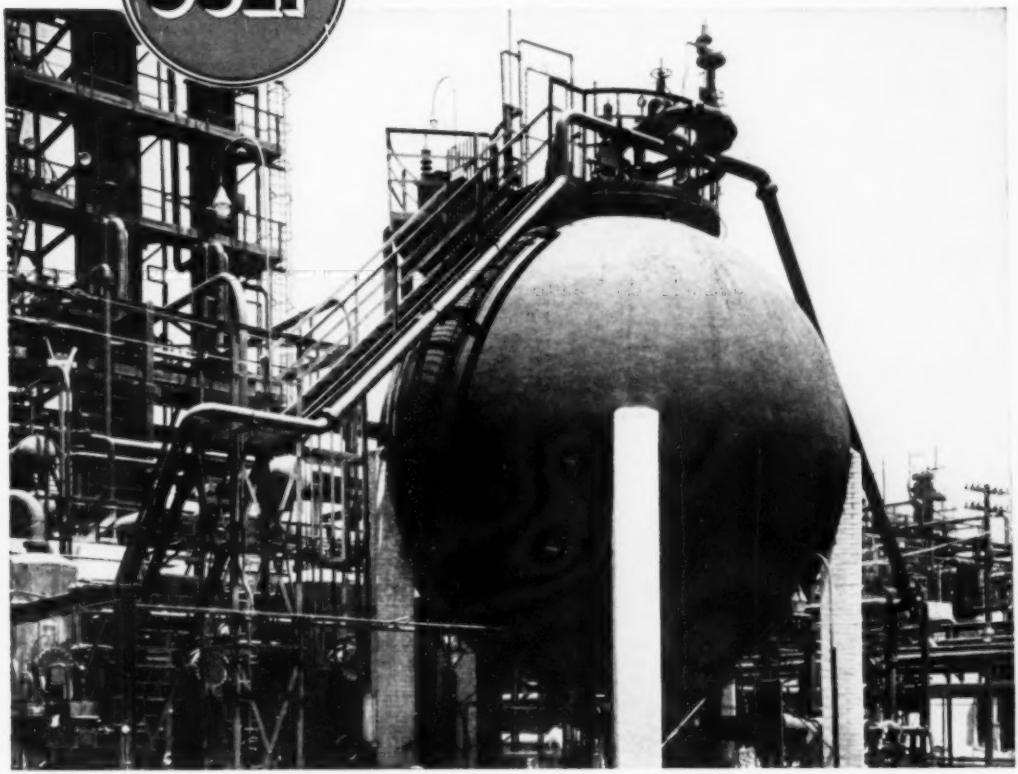
Process Instrumentation

Taylor Technology, Vol. 4, No. 2, 1951; contains four articles of interest to instrument men: 1) the control system for a Platforming unit; 2) "Transaire" pressure and temperature transmitters on an isobutanizer at Magnolia's Seeligson plant; 3) frequency response analysis to avoid cumbersome mathematics; 4) Lion Oil's sulfur-from-refinery wastes plant and its control system. Taylor Instrument Cos., Rochester 1, N. Y.

Circle No. 33 on Reply Card

GULF

another leading refiner who desalts with **PETRECO**



The Petreco Electrosphere Desalter illustrated above is one of eight separate Petreco installations in the Gulf Oil Corporation refinery at Port Arthur, Texas. Gulf also uses Petreco Desalters in its refineries at Philadelphia and Pittsburgh, Pennsylvania, Toledo, Ohio, and at Fort Worth and Sweetwater, Texas. These repeated installations by a refiner with Gulf's acknowledged leadership and refining know-how speak for themselves. If you want the best in desalting equipment, engineering, service and performance—specify PETRECO. Assure your refinery of more economical operations with

Minimum Residual Salts and Solids
Less Furnace Plugging
Less Exchanger Plugging
Reduced HCl Corrosion in Topping Section
Clear Water Bleed
Waste Oil Recovery
Trouble-free, Automatic Operation

PETRECO OFFERS COMPLETE DESALTING SERVICE AND FACILITIES

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PETRECO

SPECIALIZED *Electric* PETROLEUM PROCESSES { DESALTING / DEHYDRATING

PR 51-1

Protective Coatiggs

Cold Applied Tar Base Coatings, Form No. PCA-252, eight-page brochure lists available cold tar base coatings, with application directions and application guide table to aid in the selection of the proper coating. Pittsburgh Coke & Chemical Co., Grant Bldg., Pittsburgh 19, Pa.

Circle No. **34** *on Reply Card*

Providing More Storage Space

Planned Storage Efficiency, Bulletin No. 5221, 12-page booklet describes and illustrates especially engineered storage rack systems which save space, reduce handling costs, and add to safety and operating conditions; storage equipment, such as portable elevators, aisle savers, and the "Powerox" platform are illustrated. Barrett-Cravens Co., 4613 S. Western Blvd., Chicago 9, Ill.

Circle No. **35** *on Reply Card*

Air Cleaned and Dried

Condensifilter, Bulletin B-30; two-page bulletin describing unit which operates as a dehydrator, mechanical filter, and self-purging trap, removing entrained and vaporized water and oil, oil sludge, scale and other foreign materials from compressed air for operating instruments in combustion and process control; component parts illustrated and unit specifications included. Hankison Corp., 1501 Beaver Ave., Pittsburgh 33, Pa.

Circle No. **36** *on Reply Card*

Coating Protects all Structures

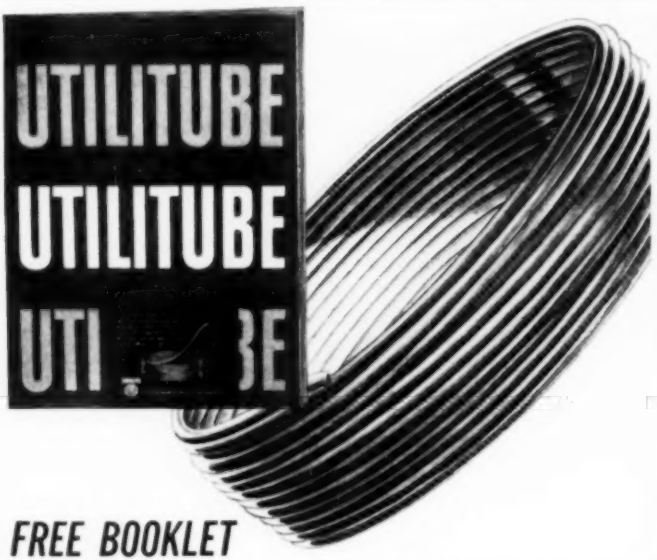
The One Best Answer for Protecting and Restoring Masonry Structures; a 20-page progress report on "Dum-Dum Masonoc," a protective coating used on bridges, oil and gasoline tanks, gas holders, quonset huts, metal beams, and metal sheds and buildings, where repeated applications of paint are difficult, expensive, inconvenient or unsatisfactory. The Arco Co., Dept. DMI, 7301 Bessemer Ave., Cleveland 27, Ohio.

Circle No. **37** *on Reply Card*

Galvanometers, Dynamometers

Galvanometers, Dynamometers and D-C Amplifiers, Section ED of Catalog E, 1952, replaces Catalog ED; newly-revised, 20-page catalog includes complete line of standard galvanometers, dynamometers, d-c indicating amplifiers, and accessories for use in null-balance or calibrated deflection measurements; includes galvanometer selector guide, replete with diagrams, also equipment listings and specifications presented in tables for comparisons. Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

Circle No. **38** *on Reply Card*



FREE BOOKLET
ON ALCOA'S NEW, ALL-PURPOSE COILED TUBE

This new booklet gives complete facts about UTILITUBE—Alcoa's new, all-purpose coiled tube. Alcoa UTILITUBE is designed to handle fuel and lubricants in engines, air in instrument systems, fluids in hydraulic systems, cutting compounds in machine tools, etc.

It will save you up to 40% on tube costs. It gives you 3 times more feet per pound. It forms, flares and bends more easily than annealed copper. It will not gum, sludge or discolor the fluids it carries. Write:

ALUMINUM COMPANY OF AMERICA
840D Gulf Building • Pittsburgh 19, Pennsylvania

Literature Offered in Issue's Advertisements

Do you need detailed information on a specific subject? Check through this easy-to-use index of literature offered in this issue:

ACTIVATED ALUMINA: Information offered by the Aluminum Co. of America. See adv't p. 535.

ADDITIVES, detergent-inhibitor type, for lube oils: Technical information offered Monsanto Chemical Co. See adv't p. 415.

ADDITIVES, for greases: Samples of "Ortholeum 500 and Phenyl-alpha-napthylamine offered by DuPont Co. See adv't p. 526.

ALKYLATION, sulfuric acid: Information, yield and inspection data offered by The M. W. Kellogg Co. See adv't p. 428-429.

ANALYSERS, sulfur & carbon: Information offered by Harry W. Dietert Co. See adv't p. 529.

BLOWERS, axial flow positive displacement: Publication No. 90 offered by Read Standard Corp. See adv't p. 340.

CATALYTIC CRACKING: Bulletin CC2521 offered by The Fluor Corp. See adv't p. 421.

CATALYST, fluid-type cracking microspheroidal and ground form: Descriptive information of-

fered by the Davison Chemical Corp. See adv't p. 456-457.

CHEMICALS for the oil industry: General Products List 100 and Technical Data Sheets offered by Hooker Electrochemical Co. See adv't p. 511.

CONDENSERS: nickel alloy; 40 page booklet offered by Haynes Stellite Co. See adv't p. 437.

COOLING TOWERS: 8 page brochure offered by The Marley Co., Inc. See adv't p. 423.

COPPER SWEETENING: Process information offered by Phillips Petroleum Co. See adv't p. 541.

DATA ANALYSIS, automatic: Illustrated brochure offered by the Telecomputing Corp. See adv't p. 404.

DIFFERENTIAL RELAY, constant for liquid level, specific gravity, etc.: Illustrated bulletin offered by Instruments, Inc. See adv't p. 566.

ELECTRIC MOTOR SELECTION & APPLICATION TRAINING COURSE: Bulletin GEA-4938-16 offered by General Electric Co. See adv't p. 464-465.

FLOW METER, with magnetic coupling to eliminate stuffing box. Catalog 50 offered by Fischer & Porter Co. See adv't p. 557.

FRACTIONATING TRAYS: Kaskade type: Bulletin No. 629 offered by Koch Engineering Co. See adv't p. 425.

GASHOLDERS: dry seal: "Pay Out Analysis" and Bulletin offered by General American Transportation Corp. See adv't p. 402.

GASOLINE STABILITY: Booklet Serial A-3109 offered by Dupont Co. See adv't frg 432-433.

HEATERS, storage-tank oil: Bulletin 1642 offered by The Grissom-Russell Co. See adv't p. 455.

HOSE, metal: Catalog U-101 offered by Universal Metal Hose Co. See adv't p. 538.

INVENTORS LABORATORY HELP: Booklet offered by Sinclair Research Laboratories, Inc. See adv't pp. 452-453.

INSTRUMENTS, control: Bulletin 9500T offered by Taylor Instrument Companies. See adv't pp. 460-461.

INSULATION, industrial: Booklet offered by The Philip Carey Mfg. Co. See adv't p. 411.

KNOCK, factors which influence: Serial A-2849 offered by Dupont Co. See adv't facing pp. 432-433.

LABORATORY WARE, fused alumina: Bulletin 793 offered by The Norton Co. See adv't p. 451.

LININGS, insulated refractory, and supports: Catalogs offered by Bigelow-Liptak Corp. See adv't p. 445.

MIST ELIMINATORS: 8 page bulletin offered by Metal Textile Corp. See adv't p. 559.

PAINTS, for the Petroleum Industry: Data offered by The Sherwin-Williams Co. See adv't p. 454.

PAINT, rust protective: Details offered by U. S. Stoneware. See adv't p. 564.

PETROLEUM INDUSTRY MOTION PICTURES—Safety, Gasoline, Fuel Knock, Service Stations, etc.: Catalog offered by Ethyl Corp. See adv't facing inside front cover.

PIPE FITTINGS, welded: Catalog No. W-3 offered by the Bonney Forge & Tool Works. See adv't p. 546.

PROCESS ENGINEERING, sulfur recovery, sweetening, cracking, gas converters and generators: Literature offered by General Industrial Development Corp. See adv't p. 528.

PUMPS, positive-displacement motor-flow type, adjustable rate: Bulletin 500 offered by Lapp Insulator Co., Inc. See adv't p. 554.

PUMPS, positive-displacement, micro-feed type, adjustable rate: Bulletin BM-5005-2 offered by Proportioneers, Inc. See adv't inside front cover.

PURIFIERS, steam and other fluids: Information offered by The V. D. Anderson Co. See adv't p. 539.

SAFETY, for small refineries: Serial A-2848 offered by The Dupont Co. See adv't frg 432-433.

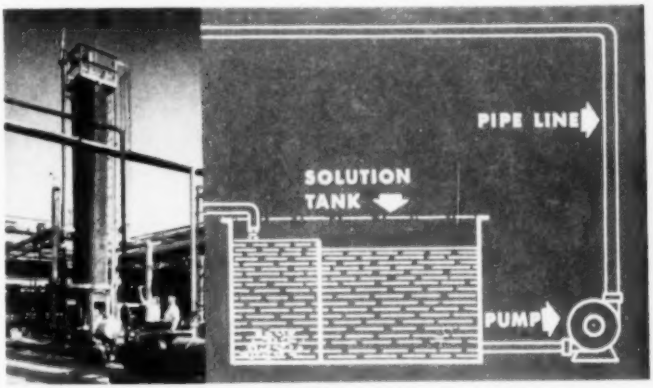
SEALS, mechanical: Booklet offered by The Garlock Packing Co. See adv't p. 420.

STEAM GAGE UNITS: Drawing GD-535 and Steam Gage Data Unit offered by Jerguson Gage & Valve Co. See adv't p. 528.

(Continued—page 564)

For Your Convenience

Business reply cards are included in each issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing the first page of this section. Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the bottom of the card and drop it in the mail. No postage required.



How to save $1000 on Tower Cleaning

Here's the blueprint of a chemical cleaning installation that saves one refiner $1000 on his tower maintenance.

Material? Recommended Oakite detergent solution for speedy, thorough removal of grease, waxes, entrained crude—iron sulfides, chlorides, oxides.

Method? *In-place* circulation of solution. No dismantling, reaming or sawing. Cuts *days* off cleaning time.

Results? Men who use it say: "Never spent 80 bucks so happily to save $1000." "Increased output 400 gallons per hour." "Good results—even trays near top come out clean."

Details? Absolutely *free*, including blueprints. Write Oakite Products, Inc., 37 Rector St., New York 6, N. Y.

Technical Service Representatives in Principal Cities of U. S. & Canada

SPECIALIZED INDUSTRIAL CLEANING

OAKITE

MATERIALS • METHODS • SERVICE

PETROLEUM SERVICE DIVISION

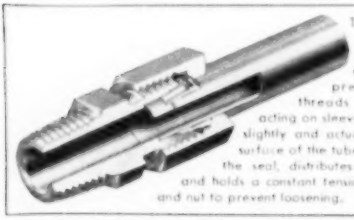
(To obtain more data on advertised products see page 552)

USING ANY OF THESE?

Machine Tools	Compressors
Marine Engines	Control Panels
Pressure Lubrication	Stationary Engines
Hydraulic Equipment	High Pressure Air
Power Plant Instruments	Material Handling Equipment
Diesel Engines	Railroad Motive Power
Hydraulic Braking Devices	Chemical Process Control Instruments
Material Flow Lines	High Pressure Steam
Refinery Instrumentation	Textile Processing Equipment

then you can
SAVE TIME AND MONEY
with Weatherhead
ERMETO®

This fitting saves up to 60% on steel tubing installation time . . . up to 40% on copper and aluminum with NO FLARING, NO THREADING, NO WELDING, NO SOLDERING. Fast installation with only a wrench. Disassembly and reassembly is easy. ERMETO meets J.I.C. requirements.



The Weatherhead ERMETO sleeve makes the difference! See how nut presses sleeve as threads engage. Forces acting on sleeve cause it to bow slightly and actually bite into the surface of the tube. This strengthens the seal, distributes vibration strains and holds a constant tension between body and nut to prevent loosening.

WRITE for complete details—get ERMETO CATALOG No. E-1457. Address: Dept. H-2, THE WEATHERHEAD COMPANY, Cleveland 8, Ohio.

The Mark of Quality
WEATHERHEAD
FIRST IN HYDRAULIC CONNECTIONS

What's New!

STEAM TRAPS. Bulletin 132 offered by W. H. Nicholson & Co. See ad(s) p. 541

STEAM TURBINES, gear type. Bulletin B-146 offered by Westinghouse Electric Corp. See ad(s) p. 545

TANKS, calibrating. Bulletin CT-101 offered by Warner Lewis Co. See ad(s) p. 507

TEMPERATURE CONTROL. Catalog No. 400 offered by Penn-Ohio Inc. See ad(s) p. 410

TOWER CLEANING. Details and blueprints offered by Hankle Products, Inc. See ad(s) p. 565

TRANSMITTERS, pneumatic pressure. Bulletin P-2520 offered by Consolidated Corp. See ad(s) p. 541

TUBE FITTINGS, for instrumentation. Catalog 4200 offered by The Parker Appliance Co. See ad(s) p. 509-511

TUBE FITTINGS, instrument tube, etc. Ermeto Catalog No. E-1457 offered by The Weatherhead Co. See ad(s) p. 563

TUBES, heat exchanger. Booklet entitled "Alcoa Aluminum Heat Exchanger Tubes" offered by The Aluminum Co. of America. See ad(s) p. 507

TUBES, heat exchanger. Information offered by The American Brass Co. See ad(s) p. 402

TURBINE, all-purpose sealed aluminum. Booklet entitled "Turbine" offered by Aluminum Co. of America. See ad(s) p. 562

VALVES, combination pressure-vacuum vent. Bulletin No. 601 offered by Bird, Swain & Bryant, Inc. See ad(s) p. 420

VALVES, control. Catalog 1200 B offered by The Atkomatic Co. See ad(s) p. 424

VALVES, gate and venturi type. Catalog 42-1951 offered by Crane Co. See ad(s) p. 404

VALVES, proportional control. Bulletin 200-2 offered by Minneapolis-Honeywell Regulator Co. See ad(s) p. 523

VALVES, pump. New catalog offered by Jenkins Pump Valve Co., Inc. See ad(s) p. 568

WATER CONDITIONING SERVICE. Bulletin No. 124 offered by W. H. & L. D. Betz. See ad(s) p. 431

It's New!

- it's different
- it's an "all-use" vinyl primer
- it virtually eliminates surface preparation
- it brushes easily — sprays beautifully
- it dries hard in minutes
- it provides excellent adhesion
- it goes under any type finish

it's TYGORUST

use it on wet or dry rusted steel, on wood, on concrete, on previously painted surfaces.

U. S. STONEWARE
Akron 9, Ohio

WRITE RIGHT NOW FOR DETAILS!

Esso Honors 40-Year Man With Diamond Pin

William F. Thiede, general manager of East Coast manufacturing for Esso Standard Oil Co., receives a diamond-studded service pin from **Dr. H. G. Burks, Jr.,** executive vice president. Mr. Thiede received the award at a dinner given by associates honoring his fortieth anniversary with the company. He became a full time employe in 1912 in the oil movement and storage department and subsequently held key positions in the company's New Jersey refineries. He has been general manager since 1949.

Dr. James E. Seebold has been promoted to assistant manager of research of Standard Oil Co. (Ind.) with headquarters in Chicago. **Robbert A. Steel** has been promoted to succeed him as director of the process division at the research laboratories at Whiting, Ind.

Dr. Seebold

Joining Indiana Standard in 1940 as a chemical engineer at Whiting, Dr. Seebold subsequently advanced to group leader, section leader, and assistant director of research. In 1950 he became director of the process division.

Dr. Seebold received his B. S. and M. S. from the University of Kentucky, and his Ph. D. from the Massachussetts Institute of Technology. While at M. I. T. he was assistant professor of chemical engineering and served as director of the Parlin, N. J., station of the School of Chemical Engineering Practice.

* * *

Willard deCamp Crater, Jr., has been appointed chief of the thermoplastics section, Chemical Division, National Production Authority in Washington, D. C. Mr. Crater, who is the assistant manager of vinyl sales for the Naugatuck Chemical Div., United States Rubber Co., has been given a leave of absence by the company in order to assume the government post.

* * *

Frederick B. Grosselfinger has been appointed technical director of the Synthetic Nitrogen Products Corp. of New York. He will work closely with **Mr. Miguel Tegtmeyer,** executive vice president, and **Dr. Werner Duehrssen,** both known in the fertilizer field, on process development as applied to petroleum refining, petrochemical processing, synthetic fuels, ammonia synthesis and gasification of coal.

Mr. Grosselfinger

From the time of his graduation from the Massachussets Institute of Technology, where he received both his B. S. and M. S. in chemical engineering, Mr. Grosselfinger has been engaged, except for war service, in work in the chemical field. From M.I.T. in 1939, he went with M. W. Kellogg Co., where he was employed in the process engineering department. He served five years in the U. S. Army Signal Corps, and upon separation from the Army joined Hydrocarbon Research, Inc. in New York City. He later worked for one year with the Atomic Energy Commission.

* * *

R. W. Baker, marketing analyst for Shell Oil Co., has been promoted to manager of the research and analysis division of the company's marketing administrative office in New York City. He will be responsible for general marketing research, analysis of marketing expense and sales trends, coordination of forecasting, and special marketing statistics.

Coincidental with the promotion of Mr. Baker is the appointment of **J. E. Morehouse,** supervisor of methods and procedures, to manager of his division. He will handle price records, studies of marketing organization, handling of government bids and coordination of marketing service procedures.

* * *

John B. Hanna has been named general superintendent of the new refinery which Standard-Vacuum Refining Co. of South Africa (Pty.) Ltd., will build at Durban, Union of South Africa. He will move his family from their Mountainside, N. J., home to Durban in April when actual construction of Stanvac's $17 million project is scheduled to start.

Mr. Hanna

Until recently Mr. Hanna was supervisor of maintenance and construction at Esso Standard Oil Co.'s Bayway Refinery. A native of Fort Wayne, Ind., he is a graduate of the University of Pittsburgh where he received a bachelor of science degree in petroleum engineering. Mr. Hanna joined Esso Standard in 1935, and transferred to the Standard-Vacuum Oil Co.'s South African affiliate early this year.

* * *

Harvey Fifer has been appointed head of Union Oil of Calif.'s newly established by-products chemical division, with headquarters in Los Angeles. A graduate of the University of Southern California, Mr. Fifer formerly was superintendent of the lube treating plant in Union's Oleum (Calif.) refinery.

* * *

The 1952 honor award for outstanding work in commercial chemical development was presented to **Mr. John P. Coe,** vice president and general manager of the Naugatuck Chemical

Div., United States Rubber Co., at the annual open meeting of the Commercial Chemical Development Association. The meeting was held March 20 at the Hotel Statler in New York City.

Elected president of the Association for the coming year was **Charles W. Wallon**, manager of the new products division of Minnesota Mining and Manufacturing Co. **Wayne E. Kuhn**, manager of technical and research division in the refining department of The Texas Co., is the vice president and president-elect.

Other officers are: executive secretary, **Lester E. Johnson**, chemical sales development, U. S. Industrial Chemical Co.; treasurer, **Nolan B. Sommer**, manager of market development division, Jefferson Chemical Co., Inc. Elected directors for two year terms were: **Gordon O. Cragwall**, director technical service division, sales development department, Charles Pfizer Co., Inc., and **G. W. Larson**, manager of technical sales and service division, Jefferson Chemical Co.

* * *

A new level of management has been established in the Shell Development Co., Emeryville, Calif., with the creation of positions called supervisor-research and supervisor-development. Named supervisors-research in the analytical department are: **G. W. Bond, E. R. Brooks, S. Groennings, T. H. Stross** and **F. T. Weiss**. Named supervisor-development in the experimental plants department are: **H. A. Cheney, D. D. Davidson, F. D. Moss** and **J. C. Rapean**.

* * *

Wesley D. Schroeder has been appointed supervisor of plasticizer research at Pittsburgh Coke & Chemical Co. He was formerly employed by the Rohm & Haas Co.

* * *

T. A. Abbott has been appointed to a new position as manager of the engineering research department of Standard Oil Co. (Indiana). **Dr. R. B. Jacobs** has been appointed as technical director of the department, also a new position.

Mr. Abbott joined Indiana Standard in 1946 as executive director of the engineering research department. A native of Kansas City, Mo., he was graduated from Washington University.

Dr. Jacobs joined the company in 1947 as associate director of the engineering research department after serving with the National Research Council. He received his Ph. D. from California Institute of Technology and did post doctorate work at Harvard and M. I. T.

* * *

Mr. Kercher

An award of $2,863, largest yet made to an employe under Socony-Vacuum Oil Co.'s suggestion system, has been won by **Peter G. Kercher**, a foreman in the welding department of the company's refinery at Casper, Wyo. He suggested a method for preventing the loss of the lead catalyst used in the refining of petroleum products. Previous ideas had proved unsuccessful when tried. A native of Oakes, N. D., Mr. Kercher has been employed by Socony-Vacuum since 1930.

* * *

Thomas M. Moore has been promoted to group leader at the Whiting, Ind., research laboratories of Standard Oil Co. (Ind.). Mr. Moore joined Indiana Standard in 1946 as a chemical engineer. A native of Evansville, Ind., he was graduated from Illinois Institute of Technology.

* * *

Harold K. Hughes, formerly assistant supervisor of the special analytical section of the Socony-Vacuum Oil Co. Laboratories, technical service department, has left the company to join the central research laboratories of Celanese Corp. of America, Summit, N. J.

* * *

Employes of Phillips Chemical Co.'s Philblack plant at Borger, Tex., have completed their second consecutive year without a lost-time accident. The safety record, representing a total of 884 consecutive days for the 335 employes, amounts to an accumulation of 1,428,479 man-hours.

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BOX 42

(To obtain more data on advertised products see page 552)

since the last lost-time injury which occurred on July 29, 1949.

The plant has received both the National Safety Council's distinguished award for its perfect record in the Chemical Section Contest sponsored by the Council in 1950, and the Joseph A. Holmes Safety Award presented at the completion of the first 1,000,000 man-hour record in the plant's history.

A. J. Head is plant superintendent and **J. W. Logan** is safety supervisor.

* * *

Dr. Charles L. Smith has been promoted by Ethyl Corp. to the newly-created post of associate director of product development in charge of agricultural chemicals. He will assist **William T. Hack**, director of product development.

Dr. Smith

Dr. Smith has been associated with Ethyl since 1949. Prior to joining the company, he was technical advisor to the National Agricultural Chemicals Assn. He has served as research entomologist at Rutgers University, where he obtained his Ph. D., manager of Doggett-Pfeil Co., and analytical chemist for Interstate Chemical Mfg. Co. He is a native of Trumansburg, N. Y.

* * *

J. S. Leach of The Texas Company, New York, has been appointed chairman of the American Petroleum Institute's Study Committee on Special Projects. Mr. Leach succeeds **A. Jacobsen**, president of Amerada Petroleum Corp., in the chairmanship.

Other members of the committee are: **A. E. Johnson**, of Argo Oil Corp., Denver, Colo.; **P. E. Lakin**, Shell Oil Co., San Francisco, Calif.; **N. C. McGowen**, of United Gas Pipe Line Co., Shreveport, La.; **R. L. Minckler**, of General Petroleum Corp., Los Angeles, Calif.; **E. L. Shea**, of The Ethyl Corp., New York; **A. A. Stambaugh**, of The Standard Oil Company (Ohio), Cleveland; **Henderson Suppler, Jr.**, The Atlantic Refining Co., Philadelphia, Pa.; **W. K. Warren**, Warren Petroleum Corp., Tulsa, Okla., and **Burl S. Watson**, Cities Service Co., New York, N. Y.

* * *

New officers of the Independent Refiners Association of Calif. are: **C. A. Johnson**, Socal Oil & Refining Co., president; **B. E. Devere**, Pathfinder Petroleum Co., vice president; **D. B. O'Neill**, vice president and general manager, and **N. D. Taylor**, Hancock Oil Co., secretary-treasurer.

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(To obtain more data on advertised products see page 562)

EDITORIALS

The Gap in Our Statistics On Heating Oil Stocks

THE current threat of a shortage in the supply of heating oils at some points in the East again points to the need for improving the industry's statistics on supplies of distillate fuels and kerosine available for domestic consumption, in this territory particularly. The past few winters, the threat of a shortage, or talk of the possibility of a shortage, has come up in some portions of New England and the Eastern seaboard area. Only once, in 1949, has an actual shortage occurred to the point where householders were inconvenienced. This instance was due to dislocation of supplies, rather than to any general insufficiency of stocks of heating oils even in this area.

Contributing to the uncertainty as to the adequacy of supplies is the almost entire lack of statistical data as to the volume of heating oils in the hands of the local oil companies who serve consumers, whose storage is known in the trade as secondary stocks. Adequate and up-to-date information is regularly collected, compiled and distributed on the volume of primary stocks. These are the supplies in refiners' tanks and in the tanks of the large water and inland terminals, served by tanker or barge, pipeline and by railroad. This data is compiled and published weekly by the Division of Statistics of the American Petroleum Institute, and on a monthly basis by the Bureau of Mines. The two sets of figures are in close enough agreement for all working purposes.

The volume of oil in the storage of the smaller heating oil distributing companies is doubtless small compared with that in primary storage. It is irregularly affected also by supplies which some of the independent distributors bring in from distant refining districts, such as the Gulf Coast. However, these secondary stocks are the supplies first drawn on in times of above-normal demand. Any evidence or indication of a shortage here for immediate needs soon comes before the householder and attracts public attention.

There are recognized difficulties, particularly in the Eastern area of concentrated heating oil consumption, in collecting data from the local distributing concerns. The operations of most of the companies are relatively small and they are not accustomed to reporting confidential data to a trade association or government agency, even though published only in terms of total figures, as are the larger oil companies. Also, there is some overlapping of memberships of individual companies in the several state and regional associations of heating oil distributors in this area. However, these do not seem to be insurmountable difficulties, in view of the benefits to the industry and the public of having at all times the complete picture of available heating oil supplies in this area of largest consumption of these products.

The heating oil distributors' associations in the area are the logical agencies to collect statistics on stocks from the individual companies, entirely on a confidential basis. Their totals only could be reported to the API Statistical Division or some other competent outside agency, which would compile and publish the tota. figures by states or other designated areas. Companies with memberships in more than one trade association could report their figures to only one agency, as selected, to avoid duplication of the data.

The statistics on secondary stocks, included with those now available on primary stocks, compiled and published monthly would greatly aid the oil companies in planning and arranging for sufficient supplies for consumers' needs at all times. This might even do away with the perennial threats of a shortage in supplies for householders. The API Statistical Division has had under study for some time the matter of collecting data on secondary stocks of heating oils. It is hoped their program can be worked out, or some other means for compiling these statistics be adopted before another oil heating season comes around. —V.B.G.

Incentive to Engineering Students

IT IS encouraging to note the instance of an oil company setting up an active program to bring the employment opportunities it can offer to the attention of students in scientific schools.

Pan-Am Southern Corp. is co-sponsor with Tulane University in a "practice school program," which calls for selected undergraduate chemical engineers to be assigned original investigations of a developmental or technical service nature at the oil company's Destrehan refinery. The problems will not be routine but will be related to the actual operating conditions in the refinery. An eight-hour day, five days a week, put in by the student on this industry work will earn him credits in his course at a value equivalent to a full semester's work in class room and laboratory.

This program of Pan-Am Southern is a constructive effort to meet the problem of supplying professional scientific personnel for industry's needs, in the face of the great inducements the government agencies are offering to attract students as well as the men serving with the industry. A general shortage of 15,000 to 25,000 chemical engineers by 1954 and 1955, as has been predicted, will affect the refining industry seriously.

Serious as this condition is, it may be only the beginning of a dearth of scientific personnel for industry's needs. Eric A. Walker, executive secretary of the Research and Development Board, speaking of the government's growing requirements in this direction, said recently: "The expanding programs planned by the Department of Defense and the Atomic Energy Commission will probably absorb something like three-fourths of the national supply of technically trained personnel."

Many more oil companies could benefit themselves and industry in general by adopting some practical means to bring to the attention of students in scientific schools the many long-term advantages which industrial employment offers as against government service in its current defense program. —E.F.G.

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